OCULAR PULSE AMPLITUDE IN NON DIABETIC PATIENTS WITH END STAGE RENAL DISEASE ON DIALYSIS AND NORMAL INDIVIDUALS USING DYNAMIC CONTOUR TONOMETRY: A CROSS-SECTIONAL STUDY

DISSERTATION SUBMITTED TOWARDS FULFILLMENT OF THE RULES AND REGULATIONS FOR THE M.S. BRANCH III OPHTHALMOLOGY EXAMINATION OF THE TAMILNADU

DR. M.G.R. MEDICAL UNIVERSITY

TO BE HELD IN APRIL, 2014

OCULAR PULSE AMPLITUDE IN NON DIABETIC PATIENTS WITH END STAGE RENAL DISEASE ON DIALYSIS AND NORMAL INDIVIDUALS USING DYNAMIC CONTOUR TONOMETRY: A CROSS-SECTIONAL STUDY

SUBMITTED BY
Dr. SHIMNA. C. P
CHRISTIAN MEDICAL COLLEGE
VELLORE

DISSERTATION SUBMITTED TOWARDS FULFILLMENT OF THE RULES AND REGULATIONS FOR THE M.S. BRANCH III OPHTHALMOLOGY EXAMINATION OF THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

TO BE HELD IN APRIL, 2014

BONAFIDE CERTIFICATE

This is to certify that this dissertation titled **"Ocular pulse amplitude in non diabetic patients with end stage renal disease on dialysis and normal individuals using dynamic contour tonometry: A cross-sectional study"** done towards fulfillment of the requirements of the Tamil Nadu Dr MGR Medical University**,** Chennai for MS Branch III Ophthalmology examination to be conducted in April 2014, is the bonafide original work of Dr. Shimna. C. P, Post Graduate student in Ophthalmology, Christian Medical College, Vellore.

Dr Lekha Mary Abraham; DO, DNB

Professor and Guide

Department of Ophthalmology

Christian Medical College

Vellore-632001

BONAFIDE CERTIFICATE

This is to certify that this dissertation titled **"Ocular pulse amplitude in non diabetic patients with end stage renal disease on dialysis and normal individuals using dynamic contour tonometry: A cross-sectional study"** done towards fulfillment of the requirements of the Tamil Nadu Dr MGR Medical University**,** Chennai for MS Branch III Ophthalmology examination to be conducted in April 2014, is the bonafide original work of Dr. Shimna. C. P, Post Graduate student in Ophthalmology, Christian Medical College, Vellore.

Dr Thomas Kuriakose; DO, DNB, FRCS (Edin)

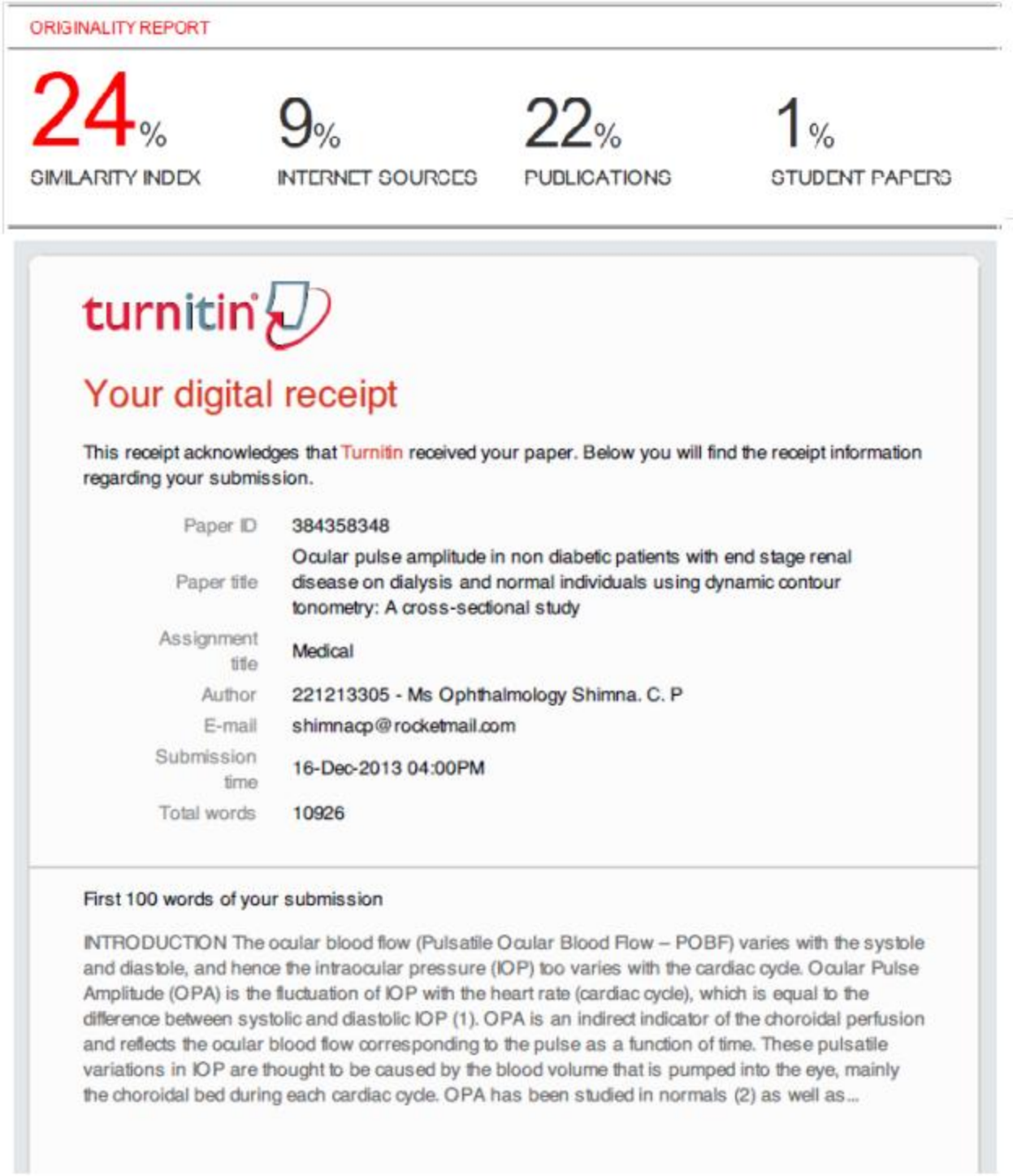
Professor and Head of the Department

Department of Ophthalmology

Christian Medical College

Vellore-632001

ANTI PLAGAIRISM CERTIFICATE



ORIGINALITY REPORT

24%	9%	22%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

turnitin

Your digital receipt

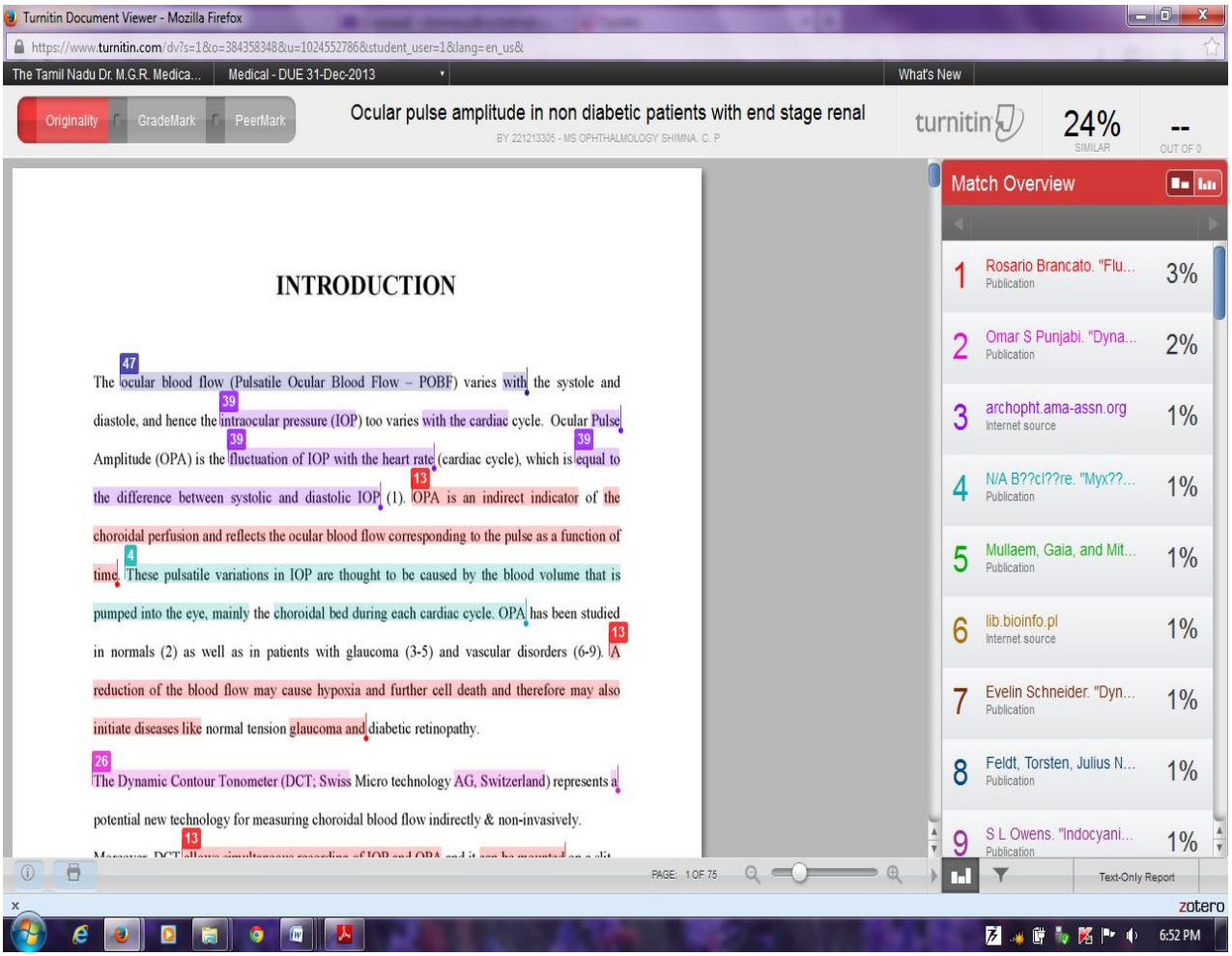
This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

Paper ID	384358348
Paper title	Ocular pulse amplitude in non diabetic patients with end stage renal disease on dialysis and normal individuals using dynamic contour tonometry: A cross-sectional study
Assignment title	Medical
Author	221213305 - Ms Ophthalmology Shimna. C. P
E-mail	shimnacp@rocketmail.com
Submission time	16-Dec-2013 04:00PM
Total words	10926

First 100 words of your submission

INTRODUCTION The ocular blood flow (Pulsatile Ocular Blood Flow – POBF) varies with the systole and diastole, and hence the intraocular pressure (IOP) too varies with the cardiac cycle. Ocular Pulse Amplitude (OPA) is the fluctuation of IOP with the heart rate (cardiac cycle), which is equal to the difference between systolic and diastolic IOP (1). OPA is an indirect indicator of the choroidal perfusion and reflects the ocular blood flow corresponding to the pulse as a function of time. These pulsatile variations in IOP are thought to be caused by the blood volume that is pumped into the eye, mainly the choroidal bed during each cardiac cycle. OPA has been studied in normals (2) as well as...

ANTI PLAGAIRISM CERTIFICATE



ACKNOWLEDGEMENTS

First of all, I would like to thank Almighty God for granting me the privilege to learn the science of Ophthalmology in this prestigious institution. I thank Him for all the blessings that he had given me in my life and I thank Him for being with me throughout the ups and downs in my life.

I am deeply indebted to Dr Lekha Mary Abraham, my Guide and my mentor who was always there to help me throughout my thesis work and I thank her for all the support and advice that she had given me throughout my course for my studies and for my life.

I am extremely grateful to my co-guide Dr. Arathi Simha R for her expertise advice and support for my thesis, giving valuable corrections and suggestions at the right time.

I am thankful to both my co-guides in Nephrology Department, Dr Vinoi George David and Dr Santosh Varghese for recruiting patients from the concerned department on time.

I would like to thank all the patients who were willing to take part in the study.

I thank all the Consultants and fellow Registrars for allowing their patients to be a part of this study.

I express my gratitude to our librarian Mr. Deenadayalan. D, for helping me to get all the necessary articles and books.

Special thanks go to Medical Records Officer, Mr. Anand Amirtaraj and his team for leading the patients to my OPD on time.

Sincere thanks to Mr. Maydhinaselvan Durairaj for helping me to take the necessary pictures.

I would like to thank my statistician, Dr. Visalatchi for helping me to do the initial stages of my statistical analysis.

I thank the Fluid Research for funding the study.

At this juncture, I would like to thank Dr Renjini, my mentor for supporting me through her prayers.

Above all, I would like to thank my family especially my mother, Dr Clara and my father, Mr. Prasad for all their support, advice and prayers. I thank them for all the wonderful things that they have done for me. I am thankful to my brothers, Rakesh and Rinesh for all their support. I would also like to thank my aunt, Mrs. Beula for all her advice and her prayers.

TABLE OF CONTENTS

INTRODUCTION

The ocular blood flow (Pulsatile Ocular Blood Flow – POBF) varies with the systole and diastole, and hence the intraocular pressure (IOP) too varies with the cardiac cycle. Ocular Pulse Amplitude (OPA) is the fluctuation of IOP with the heart rate (cardiac cycle), which is equal to the difference between systolic and diastolic IOP (1). OPA is an indirect indicator of the choroidal perfusion and reflects the ocular blood flow corresponding to the pulse as a function of time. These pulsatile variations in IOP are thought to be caused by the blood volume that is pumped into the eye, mainly the choroidal bed during each cardiac cycle. OPA has been studied in normals (2) as well as in patients with glaucoma (3-5) and vascular disorders (6-9). A reduction of the blood flow may cause hypoxia and further cell death and therefore may also initiate diseases like normal tension glaucoma and diabetic retinopathy.

The Dynamic Contour Tonometer (DCT; Swiss Micro technology AG, Switzerland) represents a potential new technology for measuring choroidal blood flow indirectly & non-invasively. Moreover, DCT allows simultaneous recording of IOP and OPA and it can be mounted on a slit lamp. OPA is an indirect indicator of choroidal blood flow. Indocyanine green angiography (ICG) was the only method available to assess choroidal perfusion and related abnormalities till recently (10). Increased arm-to-choroid circulation time and delayed intrachoroidal circulation times suggest severe choroidal hypoperfusion (11). Animal studies have shown that even brief pressure on the retinal pigment epithelium (RPE) and choroid causes immediate reduction in flow through choroidal vessels as determined by ICG (12).

Choroidal perfusion is found to be reduced in diabetic patients (13) and anatomic and histologic studies (14) prove the existence of diabetic choroidopathy. In patients with end stage renal disease who are hemodialyzed, the onset of choroidopathy depends on an early arteriolar atherosclerosis of the choroidal membrane, probably secondary to chronic renal failure rather than to hemodialysis (15). Choroidal perfusion has been found to be reduced in patients with end stage renal disease as determined by ICG (16-17). However ICG is an invasive procedure. The spectral-domain OCT, a new non invasive investigation was found to be able to image the choroid better because it offers higher resolution and faster acquisition of A-scan data in assessing the health of the choroid (18). OCT, on the other hand can image choroid only at the macula.

DCT is a non-invasive method which can measure OPA. OPA could give indirect evidence to the choroidal perfusion and may be used as an accurate non invasive tool to assess ocular perfusion especially in patients with suspected compromise in perfusion. This is particularly important in patients with end stage renal disease where indocyanine green dye angiography is contraindicated. Renal failure not only alters the renal elimination, but also accelerates the non-renal disposition of drugs that are extensively metabolized by the liver. Renal failure impairs the liver uptake of drugs and organic anions, such as bromosulphophthalein, ICG, and thyroxine, where organic anion transport polypeptides are the major transporters (19).

Till date there are no studies which have measured OPA in non diabetic patients with end stage renal disease. Studies on diabetic retinopathy and OPA have shown varying results. Hypertension and end stage renal disease are associated with choroidopathy (20-21). Since ICG angiography to look at choroidal perfusion is contraindicated in end stage renal disease,

measurement of OPA using DCT will provide us with a simple noninvasive test to detect the choroidal perfusion in these patients. It could also be helpful in looking at the choroidal perfusion after renal transplantation.

In this study we postulate that measurement of OPA can be used as a surrogate to assess the choroidal perfusion in patients with end stage renal disease. Subsequent studies on subjects with early nephropathy may give us a clue as to whether OPA measurement can be used for early detection of nephropathy which can go undetected especially in those with no retinopathy.

AIMS AND OBJECTIVES

AIMS:

1. To measure the Ocular Pulse Amplitude (OPA) in non diabetic patients with end stage renal disease (ESRD).

2. To compare the OPA in patients with ESRD with that of age matched normals.

OBJECTIVES:

1. To measure the OPA in non diabetic patients with end stage renal disease and normal individuals using Dynamic Contour Tonometry.

2. To determine whether there is a statistically significant difference between OPA between the two groups.

3. To determine the correlation between OPA and other parameters like, age, gender, intraocular pressure, blood pressure and serum creatinine levels.

LITERATURE REVIEW

Ocular perfusion and Choroidal perfusion:

Perfusion pressure which is an important factor in ocular blood flow is the difference between the mean blood pressure and the intraocular pressure (IOP). The ocular blood flow will be significantly reduced with decrease in the perfusion pressure (1) and this may lead on to ocular ischemia and hypoxia. Choroidal venous pressure exceeds the IOP slightly and arteriovenous pressure gradient is the driving force for the choroidal blood flow. The difference between the mean arterial pressure in the ophthalmic artery and the IOP gives the choroidal perfusion pressure (1)

Measurement of ocular perfusion pressure has been described by Kim et al., (22) and Zheng et al., (23) in their studies. All subjects had their blood pressure measured twice to establish stable hemodynamic condition and averaged. Mean arterial blood pressure (MAP) was calculated using the formula, MAP= DBP + 1/3 (SBP – DBP) where DBP is the diastolic blood pressure and SBP is the systolic blood pressure. Mean ocular perfusion pressure (OPP) was calculated using the equation, OPP = 2/3 (MAP – IOP).

Kim et al., investigated the correlation between choroidal thickness and ocular perfusion pressure in 64 young healthy subjects. They found that subfoveal choroidal thickness in eye with < 6 D myopia measured with the help of enhanced depth imaging optical coherence tomography study correlated significantly ($p = <0.001$) with OPP with a mean subfoveal choroidal thickness of 307.03 ± 91.27 microns and mean OPP of 44.18 ± 5.49 mm Hg. Zheng et al., described the distribution of ocular perfusion pressure and its relationship to open angle glaucoma. 3261

persons were included in the study out of which 131 cases had open angle glaucoma and they concluded that low diastolic blood pressure, low mean ocular perfusion pressure (MOPP) and low diastolic perfusion pressure (DPP) are independent risk factors for open angle glaucoma.

Ocular Pulse Amplitude (OPA):

Intraocular pressure (IOP) varies with the cardiac cycle. This variation occurs because ocular blood flow (Pulsatile Ocular Blood Flow –POBF) varies with the systole and diastole of the cardiac cycle (1). The OPA is the difference between the minimum and maximum values of the pulsatile IOP wave contour. It represents the difference between mean systolic and mean diastolic IOP. These pulsatile variations in IOP are thought to be caused by the blood volume that is pumped into the eye mainly the choroidal bed during each cardiac cycle. OPA is thus an indirect indicator of the choroidal perfusion. OPA has been studied in normals (4) as well as in patients with glaucoma (24-27) and vascular disorders (28-30). Changes in OPA following treatment of glaucoma also have been noted (31-34).

OPA in normal eyes:

In earlier studies with pneumotonometry (2), the mean OPA was found to be 1.5 ± 0.11 mmHg and with ocular blood flow analyzers (2), the OPA ranged from 2.2±0.8 to 3.0±0.92mm Hg. In a study of 148 healthy participants (223 normal eyes) using Dynamic contour tonometry (DCT), Kaufmann et al., (2) found a median OPA value of 3.0mmHg (10^{th} -90^{th} percentile range, 1.8-4.3mmHg) .The OPA difference in the 75 pair of eyes examined ranged from 0.0-2.5mm Hg (median 0.4 mmHg, 10^{th} -90^{th} percentile range, 0.1-1.2mmHg).There was no statistically

significant difference in the OPA between right and left eyes. They found no significant correlation between OPA and CCT, corneal curvature, anterior chamber depth, age or gender. There was a positive correlation between OPA and IOP (0.12 mm Hg/1 mm Hg of IOP) and a negative correlation between OPA and axial length (0.27mm Hg/ 1 mm of axial length).

Stalmans et al., (27) also found that OPA is influenced by IOP even after making the corrections for CCT. They included 28 patients with normal tension glaucoma, 19 patients with primary open angle glaucoma and 22 age-matched healthy individuals in the study. Patients underwent CCT measurements and 2 consecutive IOP measurements with Goldmann applanation tonometer and DCT. They found that the OPA increased with increase in IOP with a p value of 0.002 by Goldmann applanation tonometry and with a p value of < 0.0001 by DCT. They also found that OPA is reduced in normal tension and open angle glaucoma patients compared to normal individuals and concluded that IOP influences OPA whereas corneal thickness does not influence OPA. In a smaller study on 19 healthy subjects, Hoffmann et al., (35) described a mean OPA value of 3.08± 0.92 mmHg.

In another study of 52 eyes of 28 normal healthy adults, Purjavan et al., (36) obtained a mean OPA of 2.2 +/- 0.7 mmHg (range: 1-3.4 mmHg). The mean amplitude of diurnal OPA fluctuations was 0.4 mmHg. There was no significant difference in the mean OPA values at each time of the diurnal curve. There was positive correlation between OPA and IOP as measured using Goldmann Applanation Tonometry (GAT) ($r = 0.31$, $P < 0.0001$) and DCT ($r = 0.49$, $P < 0.0001$). There was no correlation with either blood pressure or age. OPA values of both eyes of the same individual were highly correlated ($r = 0.89$, $P < 0.0001$).

OPA in vascular disorders:

Significant asymmetry in OPA has been documented in patients with vascular stenosis (15, 16) and arteriovenous fistulas (8, 9). Most studies in diabetics (37-41) have looked into the POBF and not measured OPA directly. Ocular blood flow has been found to be near normal in mild- moderate NPDR and high in those patients with PDR. A study by Greishaber et al., (6) which looked at the relationship between OPA and systemic blood pressure measurements, showed no correlation between OPA and systolic or diastolic blood pressures or their amplitudes. They found that OPA depends strongly on the time-course of cardiac contraction.

In a study done by Golnik et al., (8) patients were divided into 3 groups in which, the first group had normal individuals, the second group had either unilateral or asymmetric orbital disease and the third group had angiographically proven cavernous sinus arteriovenous fistulas. OPA was measured using a pneumotonometer. They found that the patients in group 3 had higher OPA ($p<0.001$) compared to the other groups and successful transvascular embolization of the cavernous sinus arteriovenous fistula normalized the OPA. In another study done by Kaufmann et al., (9) OPA was found to be 4.38+/-1.23mmHg in the right eye and 9.57+/-2.71 mmHg in the left eye in patients with dural cavernous sinus arteriovenous fistula. After transvenous embolization OPA was found to be 2.84±-0.60mmHg in the right eye and 1.88±-0.29mmHg.

Savage et al., (37) compared the POBF of diabetic patients with severity of retinopathy with that of normal individuals. They did a masked cross sectional analysis with 77 diabetic subjects and 66controls. Of these 13 patients had mild or no retinopathy, 36 had moderate to severe retinopathy and 28 had proliferative diabetic retinopathy (PDR) who were previously treated with pan retinal photocoagulation. Using Langham pneumotonometry, POBF in the right eye

was measured. They concluded that POBF is unaffected in early diabetic retinopathy whereas it increases in patients with moderate to severe NPDR. Patients with PDR who have undergone laser treatment showed a significant decrease in POBF and the difference between the 4 groups was statistically significant ($p<0.0001$).

Using laser doppler flowmetry, Nagaoka et al., (41) determined choroidal blood flow in the foveal region in 70 patients with type 2 diabetes and 36 age and sex matched healthy subjects. Patients were classified into 3 groups, one group with no diabetic retinopathy, and second group with non proliferative diabetic retinopathy without macular edema (NPDR-MO) and a third group with non proliferative diabetic retinopathy with macular edema (NPDR+MO). They found that the choroidal blood flow in the foveal region with patients with NPDR+MO group was lower than that in NPDR-MO group and this indicated that the choroidal blood flow in the foveal region may decrease in the early stage of diabetic retinopathy and can worsen in presence of macular edema.

OPA in glaucoma:

Kniestedt et al., (25) studied 406 patients which included ocular hypertensives (OHT), glaucoma suspects (GS), open angle glaucoma (OAG) {including primary open angle glaucoma (POAG), normal tension glaucoma (NTG), pseudoexfoliation glaucoma (PEXG), pigment dispersion glaucoma (PDG), congenital glaucoma (CG) and juvenile glaucoma(JG).}, angle closure glaucoma (ACG) and mixed mechanism glaucoma (MMG). Eyes studied included those which had undergone cataract surgeries, filtering surgeries as well as eyes on medical treatment for glaucoma. OPA was statistically significantly higher in the subgroups of OHT and MMG and statistically significantly lower in the NTG and GS subgroups ($p=0.024$).

Punjabi et al., (42) studied the IOP and OPA in 906 eyes of 501 adults. The study included five groups- POAG, NTG, PEXG, OHT and NC (normal controls). OPA was found to be highest in OHT (3.61 mmHg) and lowest in the control group (2.86 mmHg) and significantly increased with IOP in all groups.

Stalmans et al., (27) studied patients with NTG (n=28), POAG (n=19) and age matched healthy controls (n=22).The OPA in the three groups were 2.3 ± 0.8, 2.6 ± 1.3, 3.4 ± 1.6 mm Hg. They found a clearly statistically significant difference in OPA values between healthy and NTG (p= 0.002/0.006) and a borderline significant difference between healthy and POAG (p= 0.053/0.13), but no significant difference between NTG and POAG (p=0.35/0.61) concluding that OPA is lower in glaucoma patients as compared to healthy individuals.

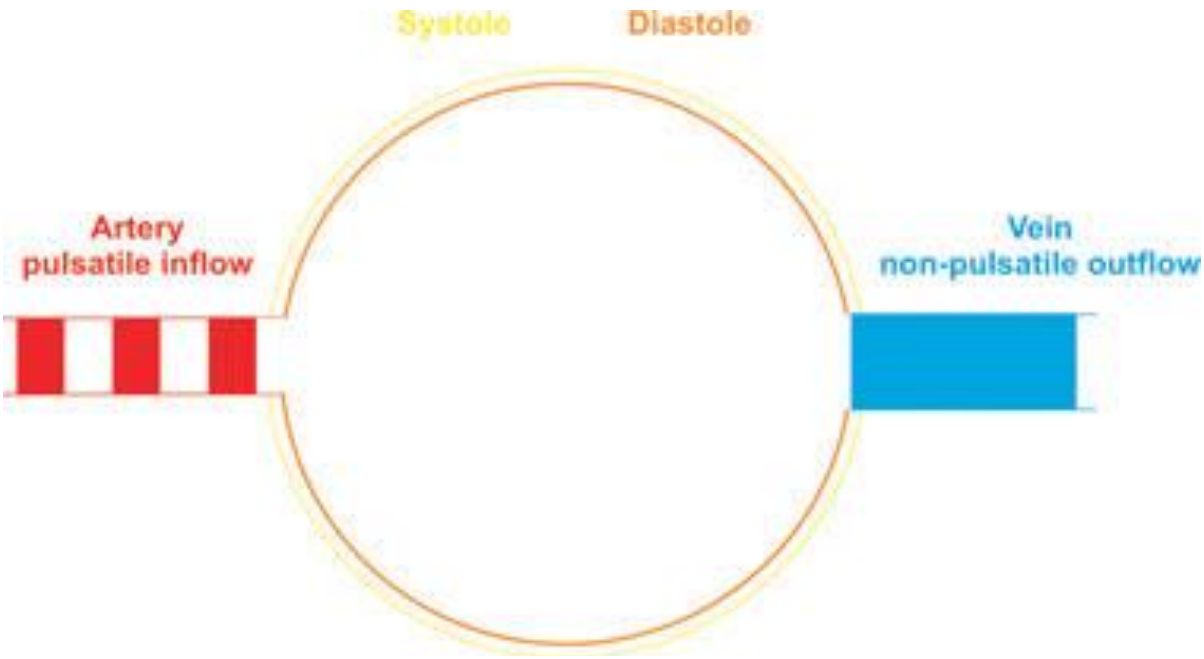
Kawabata et al., (4) studied OPA in 66 patients with NTG, 52 patients with POAG, 42 patients with OHT and 68 normal controls. The OPA in NTG was significantly lower than in normal controls ($p<0.05$).

Methods of measurement of ocular blood flow:

Pneumotonometric measurement of pulsatile ocular blood flow:

A commercially available blood flow measurement system known as OBF system 3000 by OBF Labs, Malmesbury, UK is used to determine the pulsatile ocular blood flow (43). This system measures with a pneumatic applanation tonometer and measures ocular pressure changes caused by the rhythmic filling of the intraocular vessels as shown in Figure 1.

Figure 1: Pulsatile inflow of blood into ocular arteries and non pulsatile outflow via ocular veins



Pulsatile ocular blood flow is calculated from the variation of IOP with time based on a theoretical model of eye. The theoretical model is a hydrodynamic model which is based on the assumption that inflow of blood into ocular arteries is pulsatile and outflow from the ocular veins are non pulsatile. It is also based on the assumption that ocular volume changes can be detected from changes in IOP based on a standard ocular rigidity function. The calculation of pulsatile ocular blood flow is determined by the five pulses that are closest to each other in IOP beat to beat variation.

Ocular blood flow analyzer:

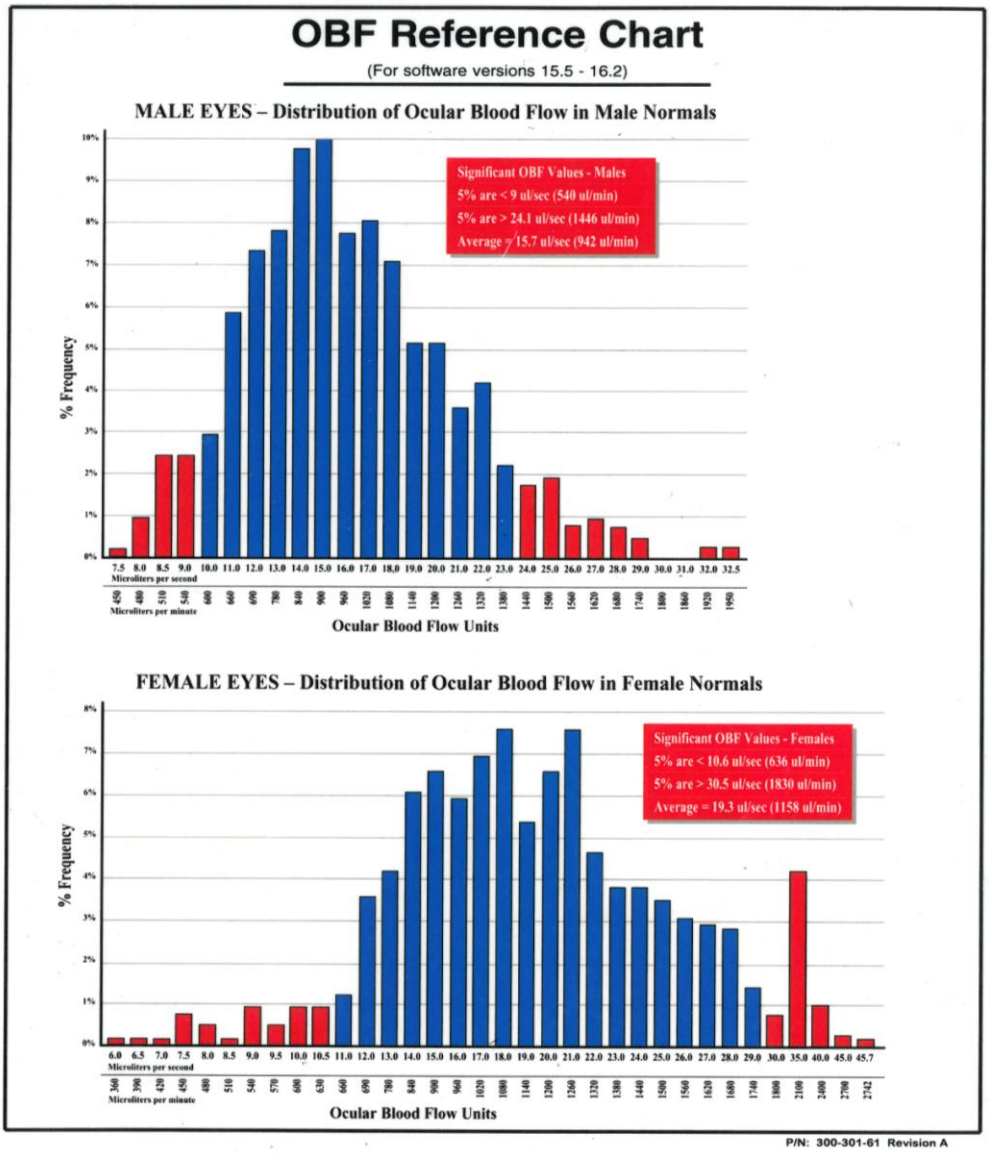
It is a comprehensive diagnostic test which uses a process known as pneumoplethysmography. The commercially available ocular blood flow analyzer by Paradigm Medical industries uses an electronic pneumatic tonometer capable of measuring and recording the IOP at a rate of 200 times per second over a period of 5-15 seconds (44).

A sterilized single use per patient probe which have an integral membrane that isolates the cornea from the internal pneumatic operation of the blood flow analyzer is used. The pulsatile ocular blood flow is derived from IOP measurements got with pneumatic tonometer and with the help of mathematical equations that link IOP to ocular volume change and volume flow.

In a single cardiac cycle, the pulsatile ocular blood flow rises to a peak value at systole rapidly and then falls slowly to a minimum value of diastole. The average pulsatile ocular blood flow is got by the ocular blood flow curve as the average of the inflow during each pulse multiplied by the number of pulses per second. Six test parameters are taken by the machine per eye including IOP, pulse amplitude, systole and diastole duration, pulse rate and ocular blood flow.

Ocular blood flow reference chart is as shown below in Figure 2.

Figure 2: Ocular blood flow reference chart



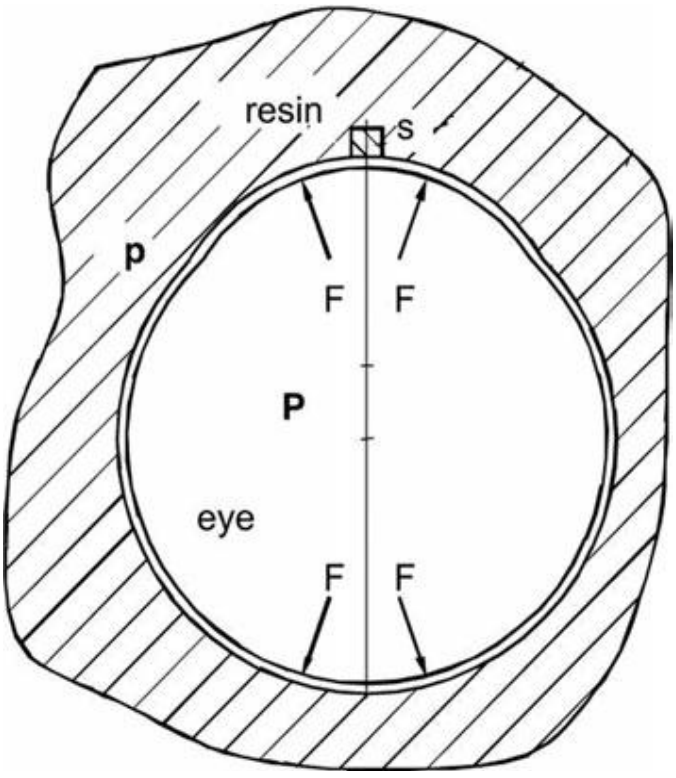
Dynamic Contour Tonometry:

It is based on the principle that when a hypothetical corneal shape is achieved, a measurement of pressure which is surface independent can be achieved. The force distribution required to gently

fit the corneal surface to the hypothetical contour counterbalances the force distribution generated by the IOP (45-49). A pressure sensor that is centrally and concavely embedded into the tonometer tip precisely measures the pressure of the eye transcorneally. In a functioning DCT device, we assume that the cornea is a spherical shell which is made up of a material that resists stretching and is fairly flexible to bending deformations. The rigidity forces due to bending and buckling are not totally without effect, but they are negligible for practical purposes.

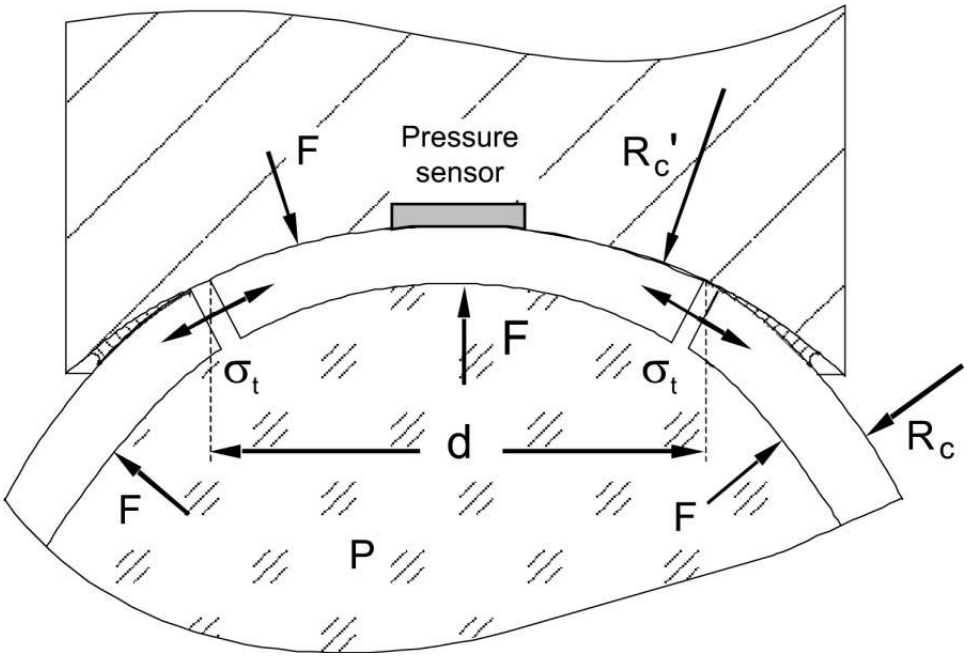
To achieve an ideal device for transcorneal pressure measurement, we need to imagine a container that is filled with casting resin surrounding an entire globe. This is as shown in the figure below (Figure 3).

Figure 2: A container filled with casting resin surrounding the entire globe



In this closed system, the resin around the eye is under a pressure '*p*'. This pressure around the resin is equal to the pressure inside the eye. The forces '*F*' generated by the IOP '*p'* act perpendicularly through the cornea and sclera and uniformly on the bulbar-resin interface. These forces are also counterbalanced by the external forces caused by the pressure in the resin. The eye floats in the resin in total relaxation. If a pressure sensor with identical surface shape is replaced for a small part of the wall, the sensor measures a pressure '*p'* that exactly corresponds to the true IOP '*P'* and the same concept applies if the surrounding sphere is only partial. So, if we take a cylindrical tip that duplicates for a part of the sphere, with a surface contour identical to the one of the whole sphere (Figure 3), the force distribution and area will also be identical (45).

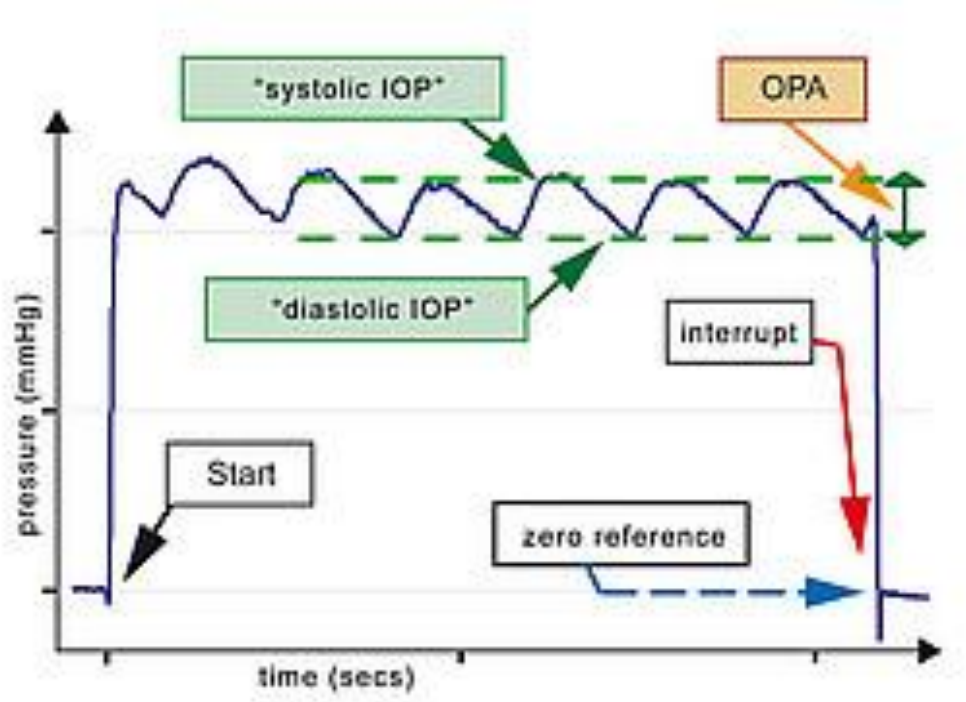
Figure 3: Dynamic contour tonometer



The distribution of the external interface forces between the tip and the cornea equals the distribution of the internal forces that are generated by the intraocular pressure. Changes in the appositional force, the corneal radius and thickness, or other corneal properties usually alter the diameter'd'. But these factors do not affect the force distribution, provided the diameter of the tip is larger than'd' and the diameter of the pressure sensor is smaller than'd'.

In the Pascal DCT device, the contoured tonometer tip has a curvature radius of 10.5 mm and a contact surface diameter of 7.5 mm. The pressure-sensitive area in the center of the contour surface has a diameter of 1.2 mm. The pressure signal from the sensor is sampled and digitized at a 100 Hz sampling rate. A built-in microprocessor provides IOP and OPA values computed from the pulse curve thus obtained (11). (Figure 4)

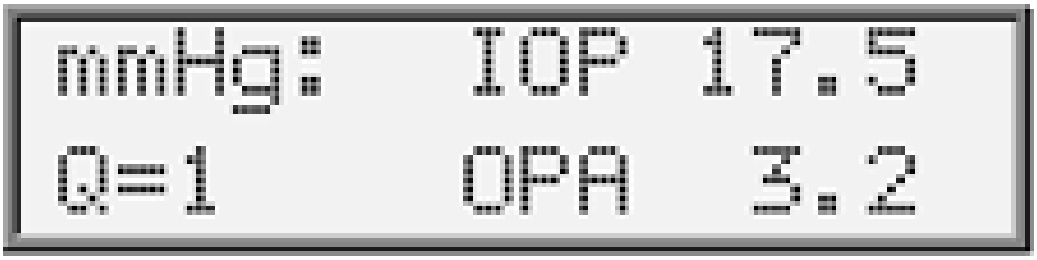
Figure 4: Ocular pressure curve with systolic / diastolic components.



The tonometer head with a contoured contact surface containing the sensor tip is applied to the centre of the patient's cornea with a small, constant force. The pressure sensor built into the contact surface of the sensor tip generates an electrical signal which is proportional to the IOP. As an audible feedback, the main unit generates the audio signal whose pitch is proportional to the IOP detected. The higher the IOP, the higher will be the pitch. The pressure signal is detected for a period of about 5 seconds corresponding to approximately 5 to 10 heart beats.

Pascal software computes IOP and its variation (modulation) caused by the cardiac pulsation (OPA) from the pressure dependent electrical signal and from the signal level after the interrupt. The signals are stored and processed in the main unit and numerical results (IOP, OPA and Q - quality factor) are displayed on an LCD display screen as shown in Figure 4. The information can be directly transferred to the computer for storage of the data including a recording (graph) of the variation in IOP during the cardiac cycle.

Figure 4:



Indocyanine Green Angiography (ICG):

In 1960, Fox and Wood described the physical and physiological properties of Indocyanine green ($C_{43}H_{47}N_2O_6S_2Na$). It is a water soluble tricarbocyanine dye of molecular weight 775. It is highly protein bound and it does not readily escape from the choriocapillaris. It absorbs near infrared portion of the spectrum at 805nm and reflects at 835nm. These special characteristics help the RPE to render invisible and facilitate visualization of the choroid through hemorrhage or other pigmentary deposits in the retina or RPE (50-52).

ICG has excellent penetration of the RPE, macular xanthophyll, other ocular pigment and even blood, which allows superior viewing of the choroidal vasculature. Visualization through media opacities is improved as longer wavelengths undergo less scatter than shorter wavelengths.

Approximately 98% of circulating ICG is bound to various serum proteins like albumin and α-lipoprotein. The dye's apparent poor penetration of capillary fenestrations in the choriocapillaris is due to this preferential binding to high-molecular-weight lipoproteins and this tendency of ICG to remain intravascular helps in the visualization of the choroidal vasculature (52). Similar to intravenous fluourescein angiography protocols, for ICG angiography, 12.5 to 50 mg or approximately 25mg of ICG dye in the manufacturer's diluent is administered intravenously in a bolus fashion. After intravenous injection, ICG is rapidly eliminated by the liver and minimal uptake in the peripheral tissues. ICG is not chemically altered in the liver. It has also been recovered in the bile unchanged. Normal ICGA has 3 phases (54-56).

Early phase:

This involves the period from the first appearance of ICG dye in the choroidal arterial circulation to the point of maximal ICG choroidal hyperfluorescence, all of which occurs within the first minute after the injection of dye. During this phase, both medium and large choroidal arteries and veins are well visualized beneath the hyperfluorescent retinal vasculature whereas individual choriocapillaris cannot be distinguished. The area surrounding the middle and large choroidal vessels appears hypofluorescent and this pseudohypofluorescence is due to the volume of blood in the choriocapillaris over the larger vessels.

Middle phase:

This starts 6 to 15 minutes after injection of ICG. A nearly homogeneous, diffuse choroidal fluorescence emerges and so the choroidal veins become less distinct and the fluorescence from the retinal vessels also begins to attenuate. Lesions that demonstrate abnormal hyperfluorescence on ICGA starts to stand out in contrast to the fading surrounding normal background fluorescence during this phase.

Late phase:

It starts beyond 18 to 30 minutes when all details of normal retinal and choroidal vessels are lost as the hyperfluorescence fades even further. The choroidal vessels could be seen now as hypofluorescent channels, retinal vessels are no longer visible, and the optic nerve head is dark. Any abnormal hyperfluorescent lesions are seen with maximal contrast.

Images are usually obtained at several-second intervals until the retinal circulation and choroidal one are maximally hyperfluorescent. Then the images are taken at approximately 30 to 60

seconds interval for the first few minutes of the study so as to capture images through the early phase of the angiogram. Further images are taken between 8 and 12 minutes for the middle phase, and then between 18 and 25 minutes for the late phase.

Indications for ICGA:

ICGA has been used in the diagnosis and management of exudative age related macular degeneration (ARMD), choroidal based tumours, to study conditions like central serous chorioretinopathy (CSCR), acute posterior multifocal placoid pigment epitheliopathy (APMPPE),multiple evanescent white dot syndrome (MEWDS), pathological myopia, Vogt Koyanagi Harada syndrome (VKH) and angioid streaks.

Side effects of ICG:

Fox and Wood have reported that there were no untoward effects seen in over 1000 patients who underwent cardiac function tests using ICG. In another large series of over 240000 intravenous injections of ICG, four patients experienced adverse reactions with one mortality. ICG is dissolved in a solvent which contains sodium iodide to prevent recrystallisation when given IV and the iodine content can cause allergic reaction. Inadvertent subcutaneous injection can cause skin discoloration for several weeks (53).

Absolute contraindications of ICG are iodine or shell-fish allergy and previous allergy to ICG. Hemodialysis (50), liver disease, allergic diathesis, pregnancy and end stage renal disease (51) are relative contraindications.

Chronic Kidney Disease (CKD):

Chronic kidney disease is defined as abnormalities of kidney structure or function which is present for more than 3 months with implications on health (57). To diagnose CKD, either of the following should be present for more than 3 months: (57)

I. Markers of kidney damage: One or more of the following:

1) Albuminuria {Albumin excretion ration (AER) ≥ 30mg/24 hours; Albumin creatinine ratio (ACR) ≥ 30mg/g [≥3mg/mmol]}
2) Urine sediment abnormalities
3) Electrolyte and other abnormalities due to tubular disorders
4) Histological abnormalities
5) Structural abnormalities detected by imaging
6) History of kidney transplantation

II. Decreased Glomerular Filtration Rate (GFR):GFR < 60ml/min/1.73m² (GFR categories G3a – G5)

According to GFR categories, chronic kidney disease is divided into 6 categories from G3a to G5. The patients who come under G5 category is called as end stage renal disease patients or kidney failure patients who are on dialysis. They have a GFR of < 15 ml/min/1.73m².

Ocular findings in patients with end stage renal disease (ESRD): (58-75)

1) Intraocular pressure: Studies which measured IOP in patients with ESRD show conflicting results. Levy et al., in a review article found that various studies showed different conclusions on the effect of hemodialysis on IOP (59). Tobvin et al., (60) measured IOP at the beginning, end and 1 hour post dialysis in 19 chronic hemodialysis patients. They found that 7 out of the 19 patients had an increase in IOP. Nongpiur et al., (61) measured IOP in 3280 Malay adults aged 40 to 79 years living in Singapore and found that there is an increase in IOP with CKD patients. Hojs et al., (62) did not find any difference in IOP before and after hemodialysis. De Marchi et al., (63) measured IOP in 55 patients on hemodialysis and found that there was no change in IOP in 44 patients, a rise in IOP in 10 patients and a decrease in IOP in 4 patients. Another study done by Tokuyama et al., (64) IOP of 32 patients with chronic renal failure on hemodialysis were measured and they found that there was a decrease in intraocular pressure post hemodialysis.

2) Corneal and conjunctival abnormalities: Patients with ESRD can develop irritable scratchy eyes which are most often due to non specific inflammation which occurs in the conjunctiva (65). Disturbances in calcium phosphate metabolism leads to calcium salt deposits especially when the calcium phosphate product is elevated and this will cause subsequent congestion of episcleral vessels with local inflammation. ESRD patients will have blink reflex abnormalities, decreases tear break up time (TBUT) and decreases goblet cell numbers (66) High levels of Vitamin A are also found to cause dry eyes and squamous metaplasia in ESRD (67).

3) Band keratopathy: It can occur due to precipitation of calcium salts on the corneal surface. Tears and aqueous humour contain calcium and phosphates. Normally, evaporation of tears concentrates these solutes and increases the tonicity of tears. In ESRD, there is elevated serum calcium or serum phosphate which can drive the solution to precipitate. Also the elevation of the surface pH out of the physiologic range changes the solubility product and causes precipitation (68).

4) Cataract formation: There is limited information regarding the direct relationship between ESRD and cataracts. Most patients with ESRD have other comorbodities that are associated with increased risk for cataracts like advanced age, diabetes, hypertension, corticosteroids, ultraviolet light exposure and hyperparathyroidism. A hypothesis for ESRD was postulated that urea enters the lens prior to dialysis due to high blood urea levels. This is followed by a rapid decrease in levels during dialysis. This causes osmotic shifts that are repeated with every dialysis cycle, eventually leading to the development of an osmotic cataract. Increased oxidative stress that is common in ESRD patients may also contribute to cataract formation (69).

5) Retinal detachment (RD): Some studies have suggested that uremia and dialysis cause changes in serum osmolarity and subsequent fluid shifts into the sub-retinal space with focal dehiscence in the pigment epithelium (70). Some other studies have hypothesized that increased chorio-capillary permeability allows larger molecules, like fibrinogen, to exit into the subretinal space causing exudative RD (71).

6) Macular edema: In patients with ESRD, when macular thickness was measured by optical coherence tomography in patients with macular edema, macular thickness was significantly decreased by hemodialysis (72).

7) Optic neuropathy: In ESRD patients, ischemic optic neuropathy is probably caused by significant intra-dialytic hypotension and may be exacerbated by concomitant anemia and decreased oxygen carrying capacity (73). However, in some patients, the increase in hematocrit and blood viscosity that occurs during dialysis and ultrafiltration can result in decreased retinal blood flow and an increased risk for ischemia. Drug-associated optic neuropathy has also been reported in patients receiving deferoxamine or OKT3 treatment (73).

Patients with end stage renal disease are at a risk for developing eye disease. The microangiopathic abnormalities are similar to kidney and eye. Hence eye is considered a window to the diagnosis of kidney disease. Ocular fundus examination gives a lot of information about the cause of renal failure of which diabetic retinopathy is the probably the most significant.

MATERIALS & METHODS

Study Design:

This is a prospective, cross sectional, observational study. The exposed group consisted of patients with end stage renal disease on haemodialysis. Age matched individuals with no systemic illnesses formed the non-exposed group.

Selection Criteria:

Patients with end stage renal disease on haemodialysis were recruited from the Department of Nephrology, Christian Medical College, Vellore. Age matched subjects were selected from patients who came for ophthalmic evaluation to the Department of Ophthalmology. Patients fulfilling the inclusion and exclusion criteria were included in the study.

Institutional Review Board (IRB) approval:

The study protocol was approved by the IRB which constituted members outside the institution as per ICMR guidelines required for any study conducted in the institution (Annexure III - IRB approval). The same way Ethical committee approval was also obtained (Annexure III - ethics committee approval)

(Reference to IRB minutes number 8167 dated 09/01/2013)

Participants:

The study was conducted in the Department of Ophthalmology, Christian Medical College, Vellore, from January 2013 to October 2013.

Inclusion criteria for exposed:

1) Patients with end stage renal disease referred from the dialysis unit. (According to glomerular filtration rate (GFR) categories, chronic kidney disease is divided into 6 categories from G3a to G5 and the patients who come under G5 category with a GFR of < 15 ml/min/1.73m² is known as end stage renal disease patients or kidney failure patients who are on dialysis)

2) ≥ 18 years of age.

3) Non diabetic patients as defined as Fasting plasma glucose (FPG) ≤ 126 mg% with no calorie intake for at least 8 hours prior according to American Diabetes Association (ADA) guidelines.

4) DCT OPA readings with Quality factor of 1 or 2.

5) Willingness to give informed consent.(Annexure II)

Inclusion criteria for non-exposed:

1) ≥ 18 years of age.

2) Systolic BP < 120 mm Hg and diastolic BP < 80 mm Hg without any anti hypertensive medications according to Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure (JNC7) guidelines.

3) Fasting plasma glucose (FPG) ≤ 126 mg% with no calorie intake for at least 8 hours prior without any anti diabetic medications according to American Diabetes Association (ADA) guidelines.

4) DCT OPA readings with Quality factor of 1 or 2.

5) Willingness to give informed consent. (Annexure II)

Exclusion criteria for exposed and non-exposed:

1) Patients with glaucoma (IOP > 24 mm Hg or suspicious discs).

2) History of transient ischemic attacks or cerebrovascular accidents.

3) Patients with any corneal pathology with preclude the accurate measurement of OPA using DCT.

4) Patients with vascular disorders like coronary artery disease (CAD), carotid stenosis, carotidocavernous fistulas and autoimmune disorders.

Methods:

Measurement of OPA:

Ocular Pulse Amplitude (OPA) was measured using Pascal's Dynamic contour tonometer. The Pascal DCT (Picture 1, Annexure IV) (Model: Ziemer S Ophthalmology, SMT Swiss Micro technology 2005), like Goldman applanation tonometer, is an accessory device installed into the optical axis of slit lamps. The Pascal DCT was mounted and aligned on a Haag Striet slit lamp (Picture2, Annexure IV). Illumination on slit lamp was set to intermediate, using white light to allow easy viewing of the Sensor Tip /Cornea interface. Sensor cap (sterile, disposable tip cover which is made especially for Pascal DCT) was fit to the Sensor Tip prior to the measurements (Picture 3, Annexure IV) and disposed after single use.

All measurements were done by a standard technique under topical anesthesia. 2 values of OPA and IOP of quality factor 1 or 2 were measured on each occasion and their average value was taken for analysis. A drop of 0.5% Proparacaine, a topical anesthetic was instilled to the patient's eye. No fluorescein was used. The patient was asked to blink a few times and then requested to keep the eye wide open and looking straight ahead. The examiner, looking from the side, aligned the end of the sensor tip close to the apex of the patient's cornea.

The Pascal unit was switched on by turning Blue Knob (Picture 3, Annexure IV) gently in clock wise direction by about 10 degrees until a click felt, and then the knob was released. The message "please wait" system test would appear on the LCD. Upon completion of the internal self test, which takes approximately three seconds, the LCD would display a reminder message "Always use cap". The LCD display would also read "OK. Recording" (Picture 4, Annexure IV) indicates that the device was active and ready to record data. Looking through left ocular, the

slit lamp is advanced until the surface of the sensor tip touched the cornea (Picture 5, Annexure IV).

The area where the sensor tip touched the patient's cornea, contact zone would appear as darker area (Picture 6, Annexure IV) that is circular when the sensor tip was properly centered. Using the joystick on the slit lamp, the position of the sensor tip was adjusted until the opaque spot enclosing the blue green square of the pressure sensor was concentric with the contact zone (Picture 6, Annexure IV) Regular continuous oscillating sound is heard which is generated by the pulsating IOP when the sensor tip had established correct contact and alignment with the cornea. Approximately 5 to 7 consecutive beeps (indicating successive cardiac cycles) are necessary to obtain an undisturbed wave form. After counting approximately five to seven wave forms of the oscillating sound the sensor tip was swiftly removed away from the patient's eye.

When pressure sensed by the Pascal drops to zero upon interruption of contact with cornea, the sound would vanish and a double beep would confirm that the zero pressure base line has been detected. This decoupling of the sensor tip from the cornea will be referred to as performing an Interrupt maneuver. The Pascal would now compute IOP and OPA from the pressure curve just recorded. The LCD is illuminated for 20 seconds and the results (IOP, OPA and QF-quality factor) displayed for a total of 60 seconds (Picture 7, Annexure IV). The results as well as the waveforms were directly transferred to the computer for data storage using appropriate software. The same procedure was restarted for the next measurements. Two measurements were taken for each patient.

Measurement of Blood Pressure:

Blood pressure of each patient participating in the study was recorded using a sphygmomanometer. Right arm of the patient was selected for measurement of blood pressure with the patient in sitting position and with the flexed elbow at the level of the heart. The arm was exposed 5 inches above the elbow and any restrictive clothing was removed. The sphygmomanometer cuff of appropriate size was wrapped around the upper arm with the lower edge one inch above the antecubital fossa.

First, the palpatory method of blood pressure recording was done. The radial pulse was found with the first 3 fingers. While palpating the radial pulse, the cuff was inflated 30 mmHg above the pressure at which the pulse disappears. The level of the pressure at which the pulse disappears and subsequently reappears on deflation was noted as the systolic pressure. Auscultatory method of blood pressure recording was done subsequently with the help of a stethoscope. Stethoscope is placed over the brachial artery on the antecubital fossa and the cuff was inflated to a level above the systolic pressure recorded with palpatory method. The cuff was gradually deflated and the pressure was noted at which the first Korotkoffs sound was heard and was recorded as the systolic pressure. The level of pressure at which the Korotkoffs sound disappears permanently was taken as the diastolic pressure.

Measurement of Blood Sugar levels:

Laboratory investigations like Fasting Plasma Glucose (FPG) and Serum Creatinine were checked for those patients in the exposed group and FPG alone was checked for the non exposed group. Fasting plasma glucose was done in the lab according to American Diabetic association

guidelines 2013 (76). Patient was advised fasting, which is defined as no caloric intake for ≥ 8 hours by ADA 2013 guidelines. Glucose orthotoluidine method was the test used to find out the FPG of each patient. Blood sample was taken in a test tube with grey cap containing sodium fluoride and the sample was centrifuged for 5 minutes. The centrifuged sample was kept in Roche Modular machine which gives the results after 20 minutes. Patients who had FPG ≤ 126 mg/dl (ADA 2013 guidelines) were diagnosed as non diabetics and were included in the study.

Serum creatinine was done in the lab using Jaffe's method. Blood sample was collected in a test tube with red cap and was centrifuged for 10 minutes. The centrifuged sample was further kept in Roche Modular machine and the results read after 20 minutes.

Sample size calculation:

Given the non availability of literature on OPA in ESRD, we conducted a pilot study to help us calculate the sample size. The pilot study consisted of 8 patients each in exposed and non exposed group. Using DCT, we measured the OPA of all the patients. The measurements with quality factor 1 or 2 were taken and compared. When we compared the values that we obtained during the pilot study, we found that the OPA of patients with end stage renal disease (exposed group) were significantly lower than the normal individuals (non exposed group). The values that we obtained are as shown in the following table.

OPA in End stage renal disease patients	OPA in normal individuals
1.8	3.5
0.8	2.8
1.2	2.3
0.8	3.5
1.5	3.4
1.3	3.1
3.4	3.2
2.9	3.1

We used two mean hypotheses testing for obtaining the sample size and we got a sample size of 44 in each arm using the following formula,

$$n = \frac{\left(Z_{\alpha/2} + Z_{1-\beta}\right)^2 * 2 * s^2}{d^2}$$

Where 'n' is the sample size,

'α' is the error,

'1-β' is the power,

'S' is the standard error and

'd' is the clinically meaningful difference between the 2 groups.

The sample size calculation was obtained as shown in the following table.

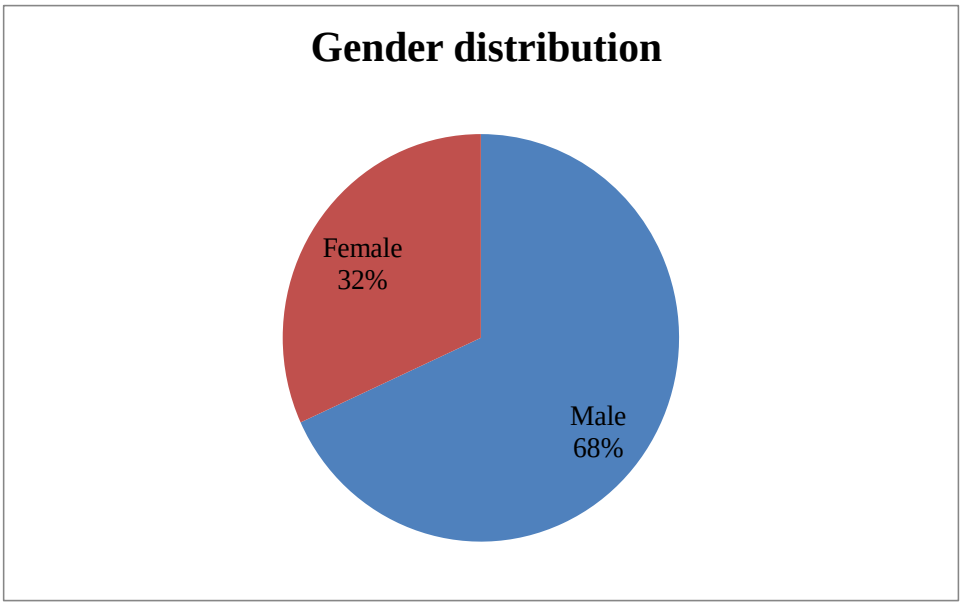
Two mean hypothesis testing for two means					
SD in Group 1	2	2	2	2	3.5
SD in Group 2	1	1	2	3	2.5
Mean difference	1.2	1.5	1.5	1.5	1.5
Effect size	0.8	1	0.75	0.5	0.6
Alpha error	5	5	5	5	5
Power(1-beta) %	81	80	80	80	80
1 or 2 sided	2	2	2	2	2
Required sample size per group	28	17	28	63	44

Data entry was done in an excel sheet and analyzed using SPSS version 17. The OPA in both eyes were averaged separately for all 88 subjects (44 exposed and 44 non-exposed) and used for analysis using Mann Whitney U test. Student t test was also used to look at statistical significance on parameters such as OPA and IOP in the exposed and the non exposed groups. We also looked at correlation between OPA and parameters like age, gender, IOP and BP and serum creatinine levels in patients with ESRD, using Pearson's correlation coefficient (r).

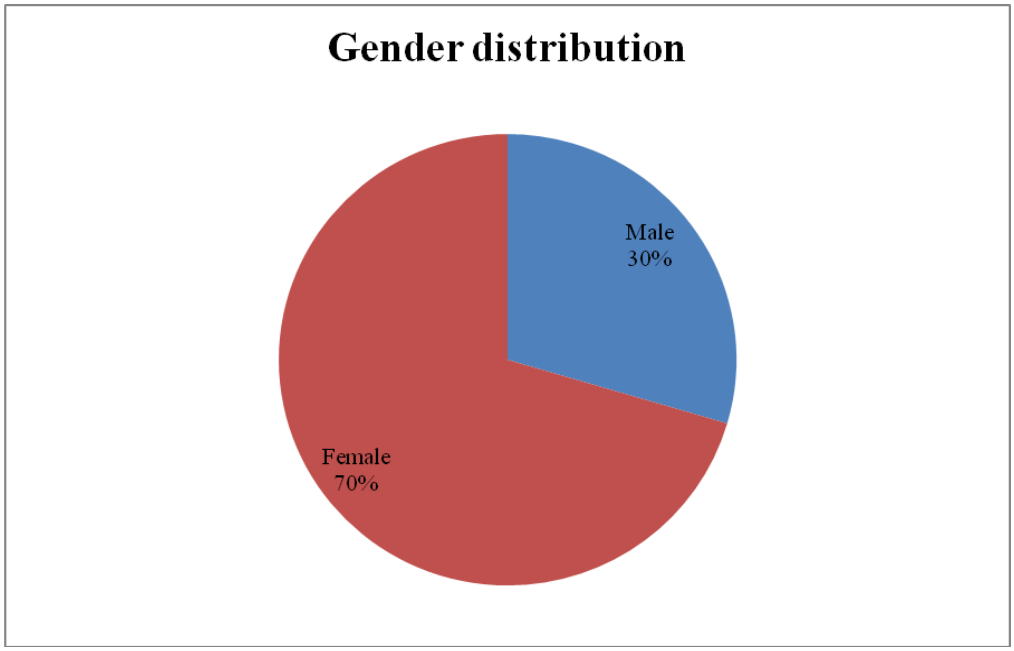
RESULTS AND ANALYSIS

The data collected from 44 patients among the exposed and 44 patients among the non-exposed group were analyzed. Among the exposed group, 30 male patients and 14 female patients participated in the study (Graph 1) whereas among the non-exposed group, 13 male patients and 31 female patients took part in the study (Graph 2). The averaged OPA in the right and left eyes of each patient was used separately for analysis.

Graph 1: Male to female ratio in the exposed group:

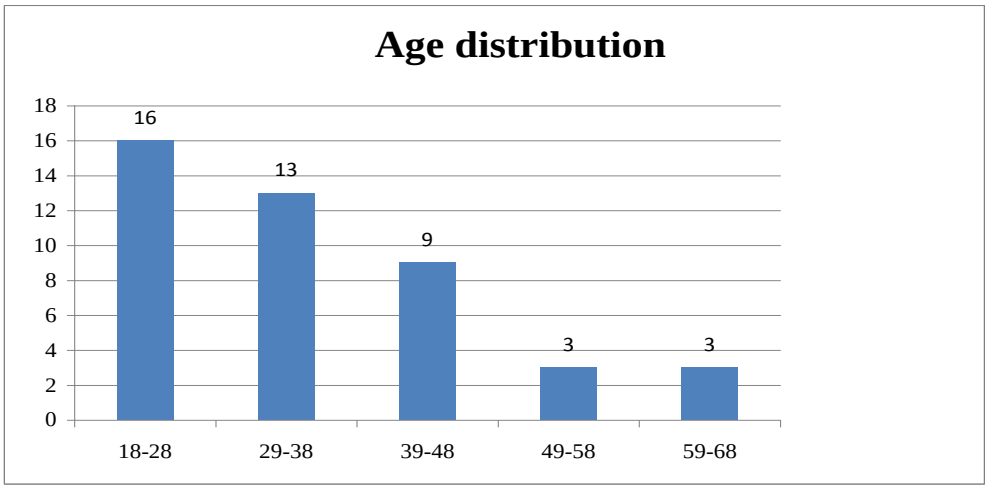


Graph 2: Male to female ratio in the non-exposed group:

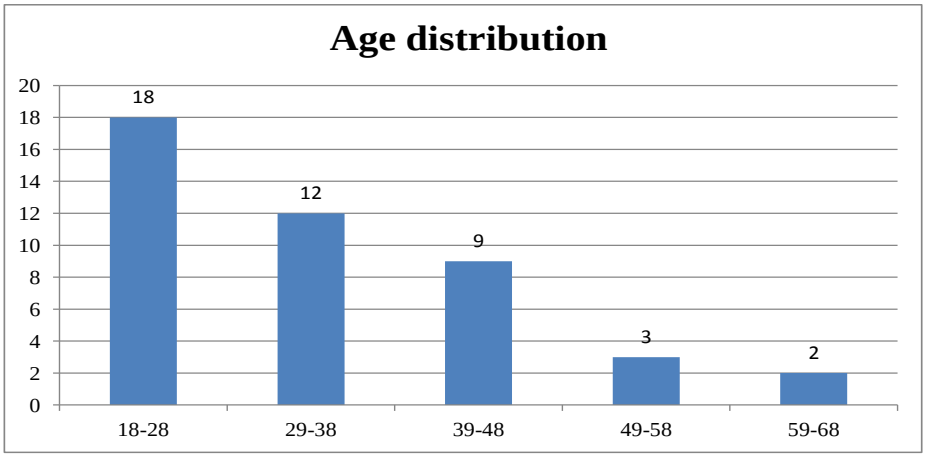


In the exposed group we had patients from 18 years to 67 years of age (Graph 3). Hence we recruited age matched individuals from 18 to 64 years (Graph 4) to form the non-exposed group. Among the exposed group, 16 patients were under the age group of 18-28 years, 13 patients were under the age group of 29-38 years, 9 patients were under the age group of 39-48 years, 3 patients were under the age group of 49-58 and 3 patients were under the age group of 59-68 years. Among the non-exposed group, 18 patients were under the age group of 18-28 years, 12 patients were under the age group of 29-38 years, 9 patients were under the age group of 39-48 years, 3 patients were under the age group of 49-58 years and 2 patients were under the age group of 59-68 years.

Graph 3: Age distribution among the exposed group:



Graph 4: Age distribution among the non- exposed:



Ocular Pulse Amplitude (OPA):

OPA was measured for each eye separately. The means and standard deviations (SD) of the OPA for each eye was calculated for both the exposed and non exposed groups. The standard error was calculated using the formula SE = SD/√n where n is the sample size. The 95% confidence interval was then calculated.

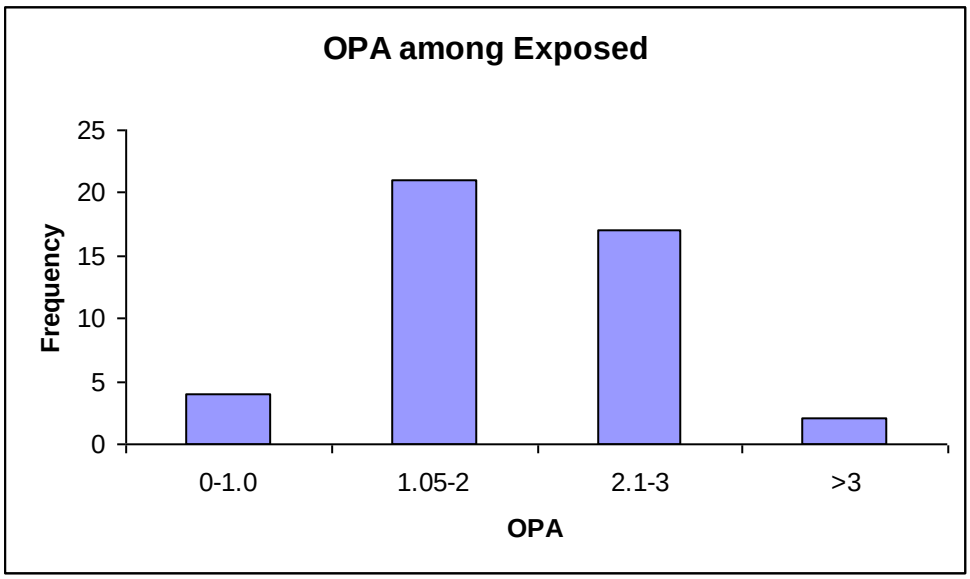
Among the exposed group in the right eye, 4 patients had OPA < 1.0 mm Hg, 21 patients had OPA between 1.1-2.0 mm Hg, 17 patients had OPA between 2.1 to 3.0 and 2 patients had OPA between 3.1-4.0 mm Hg. The distribution of OPA among the exposed group is as shown below (Table 1).

Table 1: OPA among the exposed group (right eye):

OPA	FREQUENCY	PERCENTAGE
0.0-1.0	4	9.09
1.1-2.0	21	47.73
2.1-3.0	17	38.64
3.1-4.0	2	4.54

The mean OPA (RE) in the exposed group was 1.945 ± 0.65 mm Hg. The standard error SE was calculated to be 0.098. Thus the OPA in the right eye in patients with ESRD was found to be 1.945(CI: 1.847 - 2.043). The frequency distribution of OPA in the exposed group is given in the histogram below (Graph 5)

Graph 5: OPA in the exposed group (right eye):



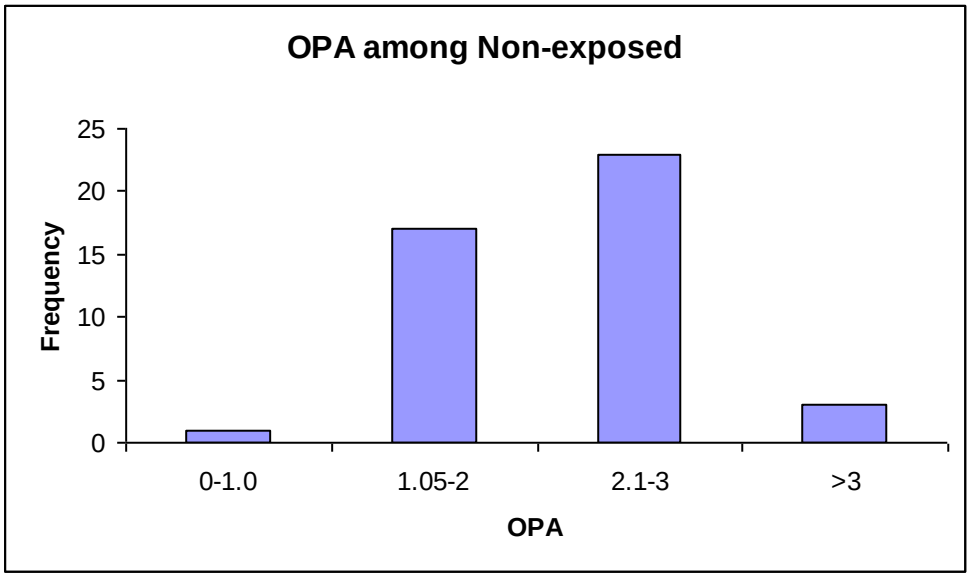
OPA among the non-exposed (right eye) ranged from 1.0 to 3.25 mm Hg. Among the non-exposed group, 1 patient had OPA between 0.0 to 1.0, 17 patients had OPA between 1.05-2.0 mm Hg, 23 patients had OPA between 2.1-3.0 mm Hg and 3 patients had OPA between 3.1-4.0 mm Hg. The distribution of OPA among the non-exposed group is as shown below (Table 2).

Table 2: OPA among the non-exposed group (right eye):

OPA	FREQUENCY	PERCENTAGE
0.0-1.0	1	2.27
1.05 -2	17	38.64
2.1-3.0	23	52.27
3.1-4.0	3	6.82

The mean OPA (RE) in the non exposed group was 2.16 ± 0.58 mm Hg. The standard error SE was calculated to be 0.087. Thus the OPA in the right eye in normal subjects was found to be 2.16(CI: 2.08-2.24). The frequency distribution is as shown in Graph 6.

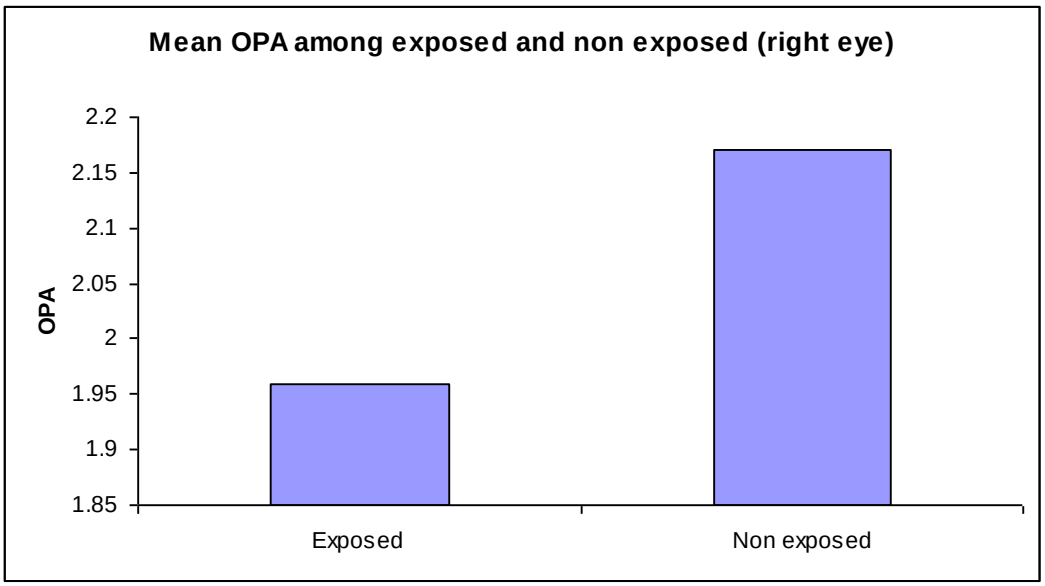
Graph 6: OPA in the non-exposed group (right eye):



Comparison of OPA among exposed and non-exposed group (right eye):

The mean OPA in the exposed group and non-exposed group were 1.945(CI: 1.847 - 2.043) and 2.16(CI: 2.08-2.24) respectively. The exposed group had lower OPA as compared to non-exposed group. There was a statistically significant difference between the 2 groups (p = 0.03). The confidence intervals do not overlap. Graph 7 shows the mean OPA in the right eye among exposed and non exposed subjects.

Graph 7: OPA among exposed and non-exposed:



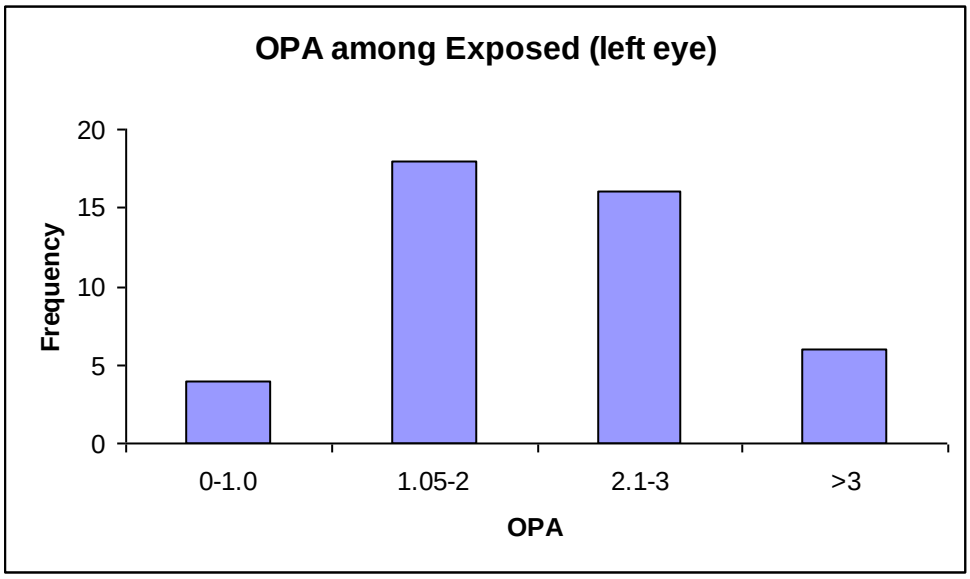
Among the exposed group in the left eye, 4 patients had OPA ≤1.0 mm Hg, 18 patients had OPA between 1.1-2.0 mm Hg, 16 patients had OPA between 2.1 to 3.0and 6 patients had OPA between 3.1-4.0 mm Hg The distribution of OPA among the exposed group is as shown below (Table 3).

Table 3: OPA among the exposed group (left eye):

OPA	FREQUENCY	PERCENTAGE
0.0-1.0	4	9.09
1.1-2.0	18	47.73
2.1-3.0	16	38.64
3.1-4.0	6	4.54

The mean OPA (LE) in the exposed group was 2.10± 0.80 mm Hg. The standard error SE was calculated to be 0.12. Thus the OPA in the left eye in patients with ESRD was found to be 2.10(CI: 1.98 - 2.22). The frequency distribution of OPA in the exposed group is given in the histogram below (Graph 5)

Graph 8: OPA in the exposed group (left eye):



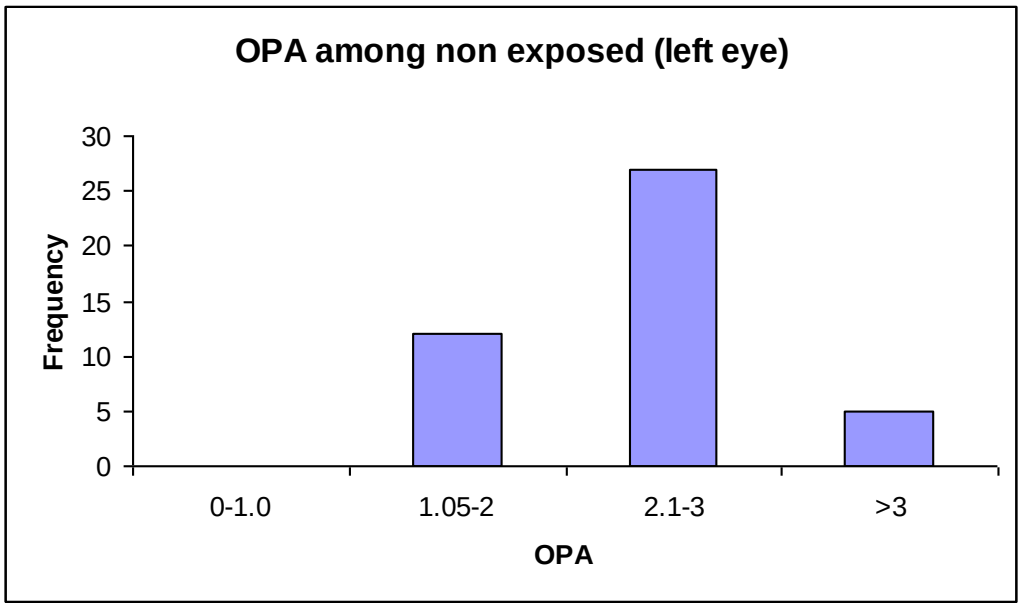
OPA among the non-exposed (left eye) ranged from 1.0 to 3.25 mm Hg. Among the non-exposed group, 12 patients had OPA between 1.05-2.0 mm Hg, 27 patients had OPA between 2.1-3.0 mm Hg and 5patients had OPA between 3.1-4.0 mm Hg. The distribution of OPA among the non-exposed group is as shown below (Table 4).

Table 4: OPA among the non-exposed group (left eye):

OPA	FREQUENCY	PERCENTAGE
0.0-1.0	0	0
1.05 -2	12	27.27
2.1-3.0	27	61.36
3.1-4.0	5	11.37

The mean OPA (LE) in the non exposed group was 2.35 ± 0.53 mm Hg. The standard error SE was calculated to be 0.07. Thus the OPA in the right eye in normal subjects was found to be 2.35(CI: 2.28-2.42). The frequency distribution is as shown in Graph 6.

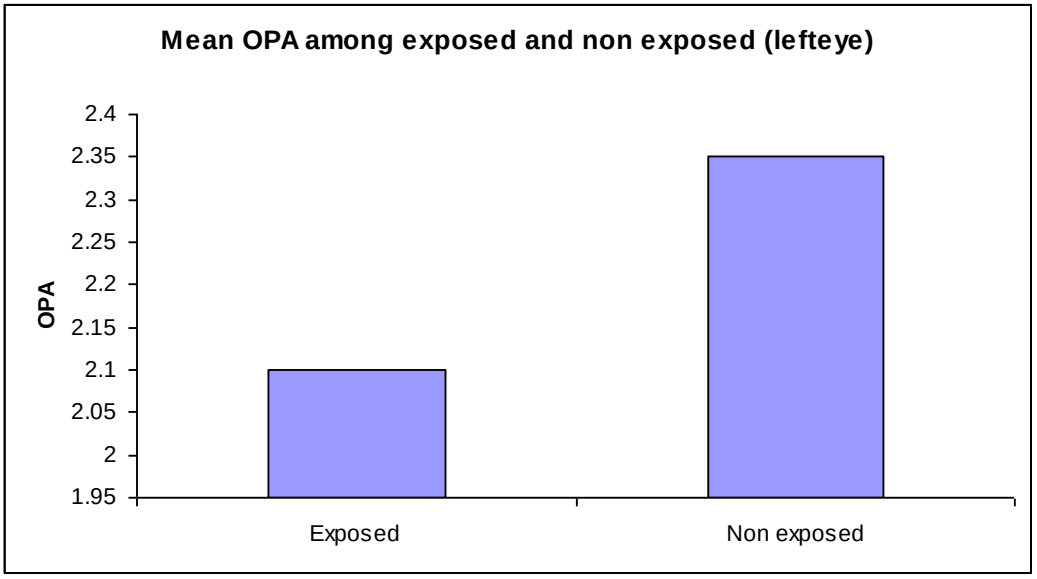
Graph 9: OPA in the non-exposed group (left eye):



Comparison of OPA among exposed and non-exposed group (left):

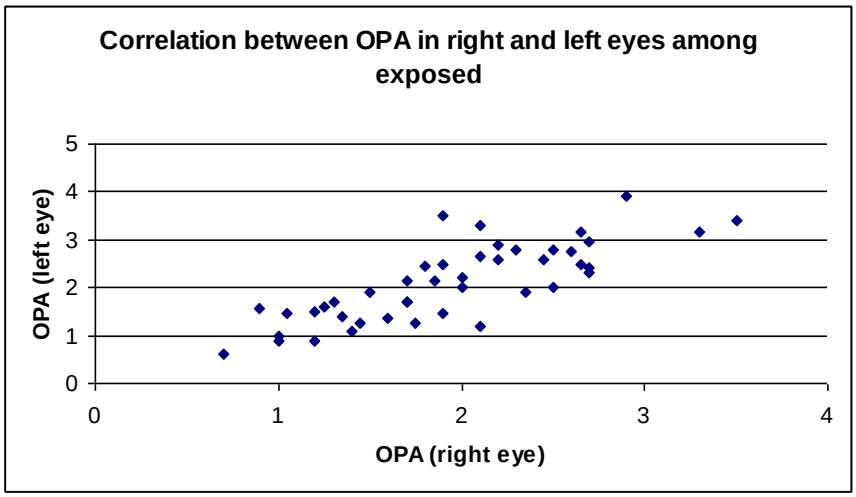
The mean OPA in the exposed group and non exposed group were 2.10(CI: 1.98 - 2.22) and 2.35(CI: 2.28-2.42) respectively. The exposed group had lower OPA as compared to non exposed group. There was a statistically significant difference between the 2 groups (p = 0.02). The confidence intervals do not overlap. Graph 7 shows the mean OPA in the right eye among exposed and non exposed subjects.

Graph 10: OPA among exposed and non – exposed:



There was a strong positive correlation between OPA in right and left eye (r=0.79) among the exposed group.

Graph 11: Correlation between OPA in the right eye and left eyes among exposed:



There was only a moderate correlation between OPA in the right and left eyes among the non-exposed (r=0.32).

Graph 12: Correlation between OPA in the right and left eyes among non – exposed:

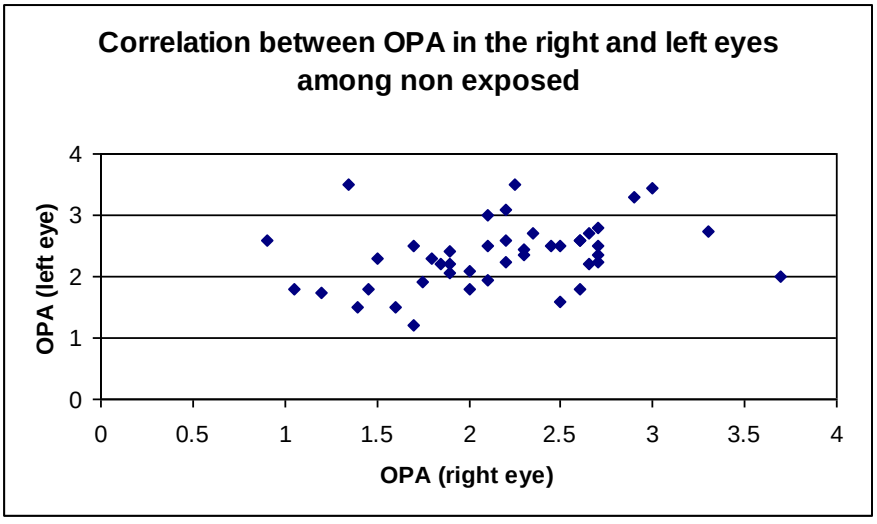
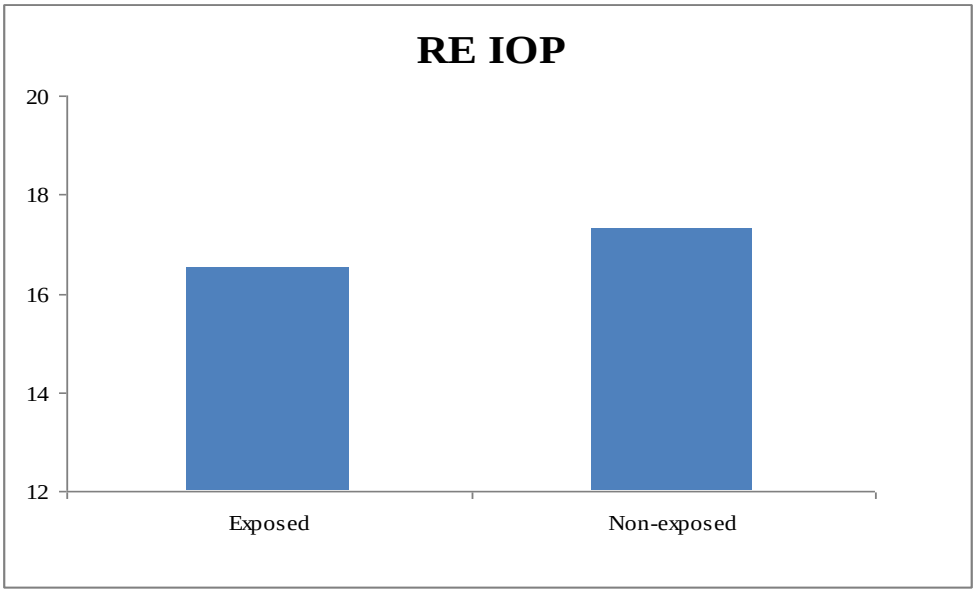


Table 5: Comparison of IOP in the right eye among exposed and non-exposed group:

	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP (right eye)	16.53	2.43	17.31	2.80	0.083

Graph 13: Bar diagram showing comparison of IOP in the right eye among exposed and non-exposed group:



IOP in the right eye among exposed was slightly lower than the non-exposed group but was not statistically significant. The IOP in the left eye also showed a similar trend.

Table 6: Comparison of IOP in the left eye among exposed and non-exposed group:

	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP(Left eye)	16.39	2.44	16.64	3.17	0.579

The median age of subjects in the exposed and non exposed groups was 30. Hence we looked at OPA in those patients who were ≤ 30 years and those who were > 30 years.

Table 7: Comparison of OPA in the right eye in age ≤ 30 years among exposed and non-exposed group:

AGE ≤ 30	**EXPOSED**		**NON-EXPOSED**		**p VALUE**
	MEAN	SD	MEAN	SD	
OPA (Right eye)	1.70	0.61	1.78	0.66	0.70

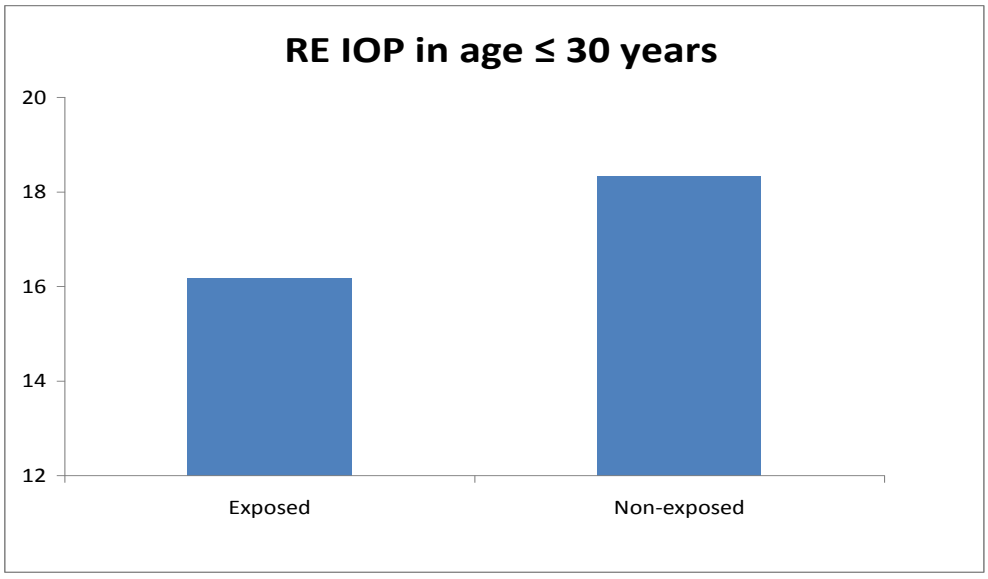
OPA in the right eye in the age group ≤ 30 years (n=21) was slightly lower in exposed group compared to non-exposed group and it was not statistically significant.

Table 8: Comparison of IOP (right eye) of age ≤ 30 years among exposed and non-exposed group:

AGE ≤ 30	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP (Right eye)	16.17	1.99	18.34	2.19	0.03

RE IOP in age group ≤ 30 years was lower in the exposed group compared to the non-exposed group and it was statistically significant.

Graph 14: Bar diagram showing comparison of RE IOP in age ≤ 30 years:



IOP in the right eye in age group < 30 years was lower in the exposed group compared to the non-exposed group and it was statistically significant.

Table 9: Comparison of IOP (left eye) in age ≤ 30 years among exposed and non-exposed group:

AGE ≤ 30	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP(Left eye)	16.27	1.92	17.33	2.86	0.228

IOP in the left eye in the age group < 30 years was lower in the exposed group compared to the non-exposed group and it was not statistically significant.

Graph 15: Bar diagram showing comparison of IOP (left eye) in age ≤ 30 years:

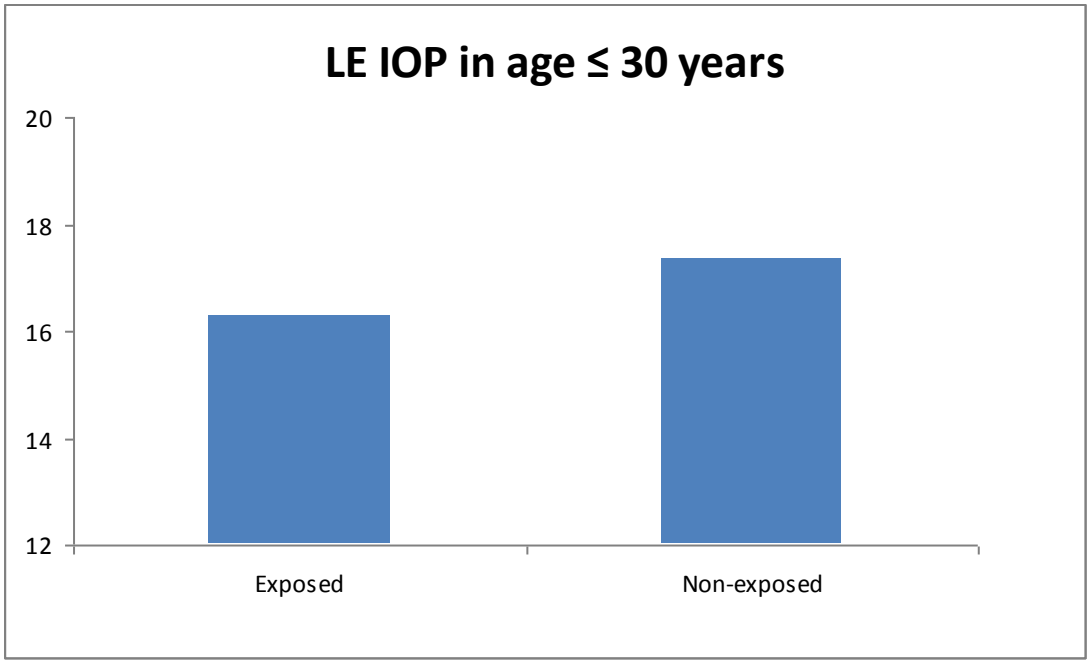


Table 10: Comparison of OPA (right eye) in patients with age > 30 years among exposed and non-exposed group:

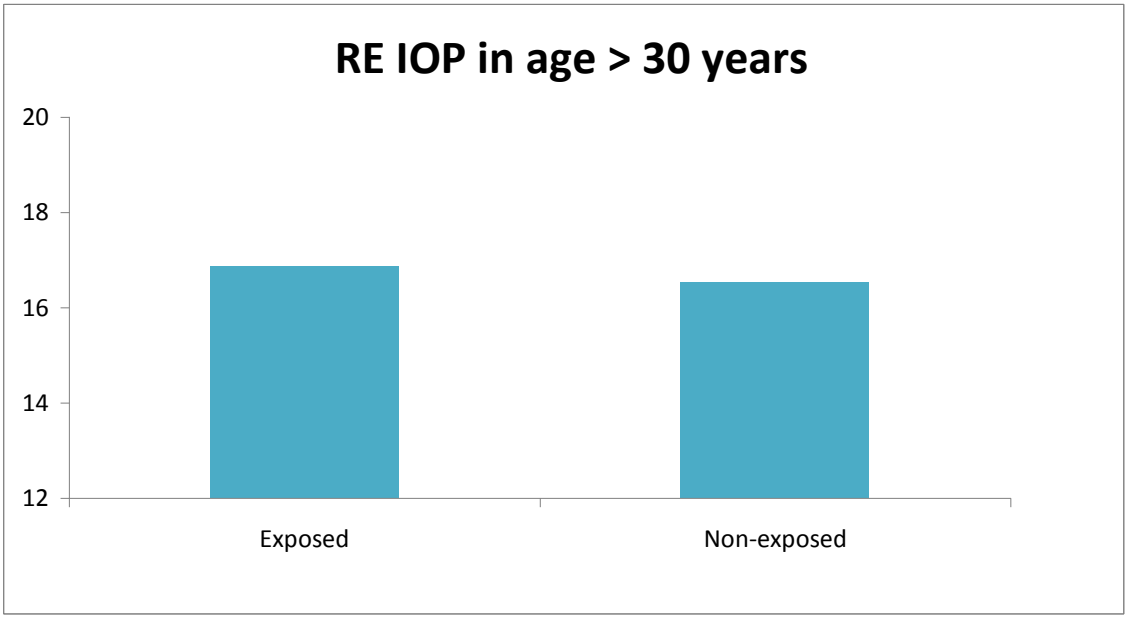
AGE > 30	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	0.288
OPA (right eye)	2.41	0.89	2.69	0.88	

OPA in the right eye in patients with age > 30 years of age was lower among the exposed compared to non-exposed group, but it was not statistically significant.

Table 11: Comparison of IOP (right eye) in age > 30 years among exposed and non-exposed group:

AGE > 30	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	0.934
IOP (right eye)	16.86	2.78	16.53	3.00	

Graph 16: Bar diagram showing comparison of IOP (right eye) in age > 30 years:

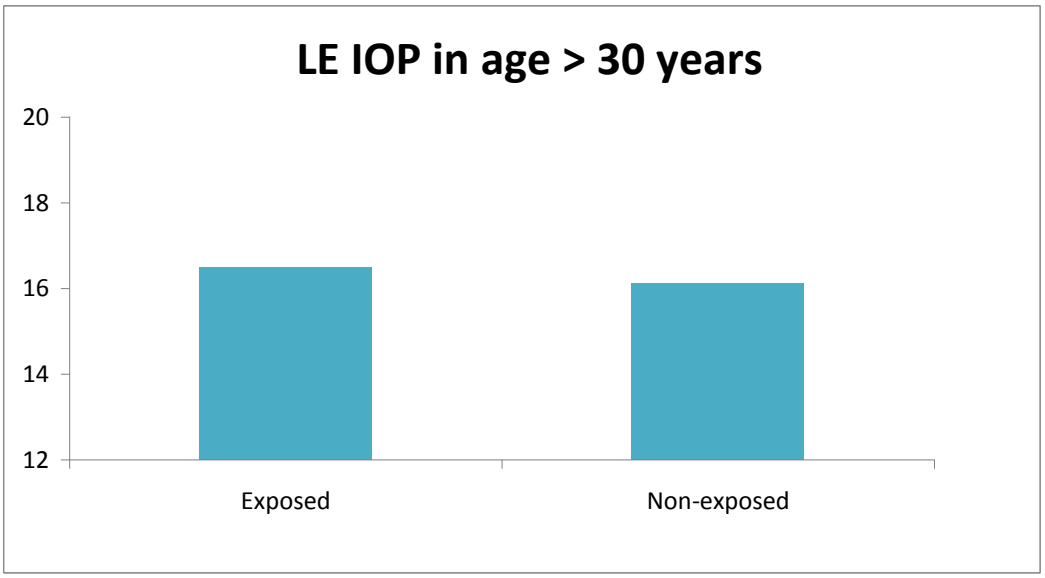


IOP in the right eye in the age group > 30 years was higher in the exposed group compared to the non-exposed group, and it was not statistically significant.

Table 12: Comparison of IOP (left eye) in age > 30 years among exposed and non-exposed group:

AGE > 30	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP(left eye)	16.50	2.84	16.12	3.27	0.773

Graph 17: Bar diagram showing comparison of LE IOP in age > 30 years:

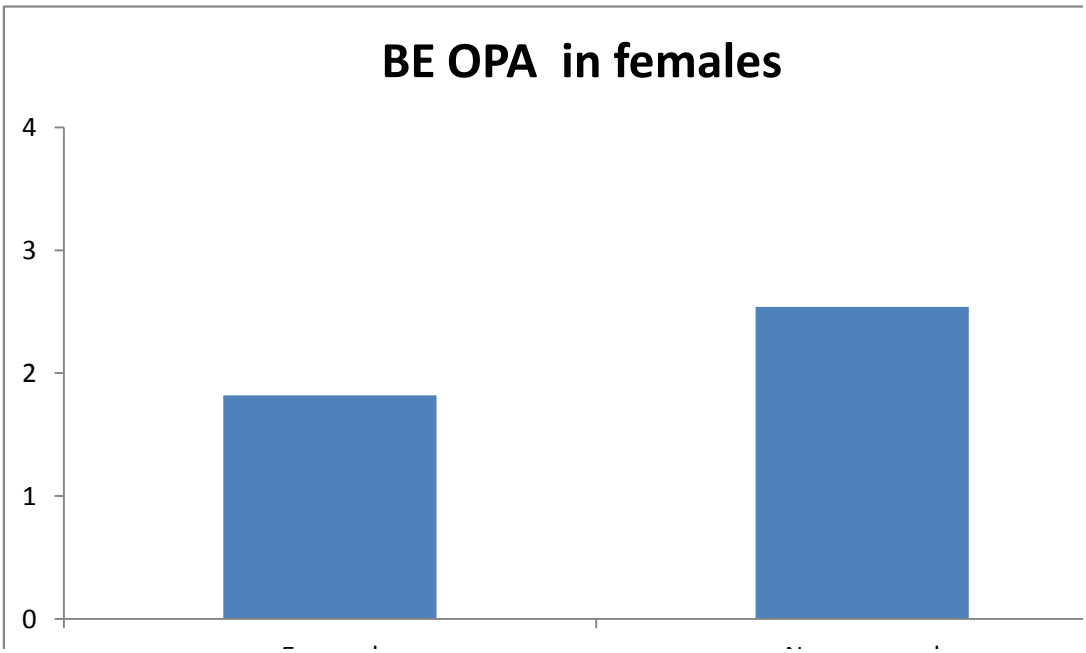


IOP in the left eye in the age group > 30 years was higher in the exposed group compared to the non-exposed group, and it was not statistically significant.

Table 13: Comparison of OPA (both eyes) in females among exposed and non-exposed group:

FEMALES	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
OPA (both eyes)	1.82	0.88	2.54	0.81	0.008

Graph 18: Bar diagram showing comparison of BE OPA in females:

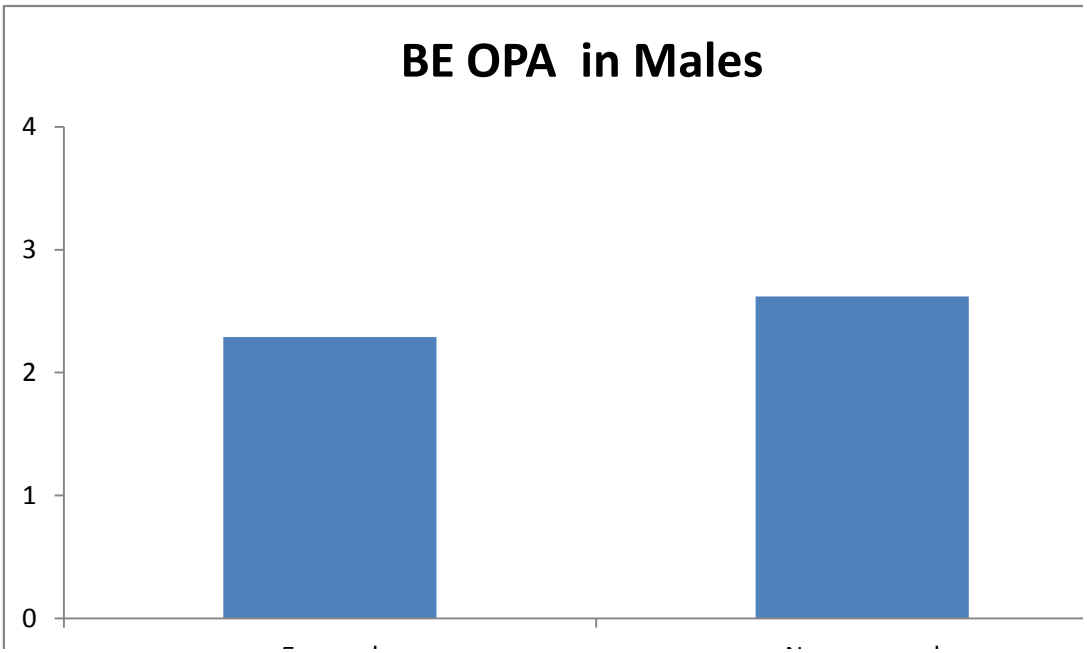


OPA in both eyes in female patients was lower among the exposed compared to non-exposed group and it was not statistically significant.

Table 14: Comparison of OPA (both eyes) in males among exposed and non-exposed group:

MALES	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
OPA (both eyes)	2.29	0.93	2.62	0.77	0.182

Graph 19: Bar diagram showing comparison of BE OPA in males:



OPA in both eyes in male patients was lower among the exposed compared to non-exposed group but was not statistically significant.

Table 15: Comparison of IOP (right eye) in females among exposed and non-exposed group:

FEMALES	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP (right eye)	16.88	2.19	16.90	2.58	0.548

IOP in the right eye in females was lower in the exposed group compared to the non-exposed group, but it was not statistically significant.

Graph 20: Bar diagram showing comparison of RE IOP in females:

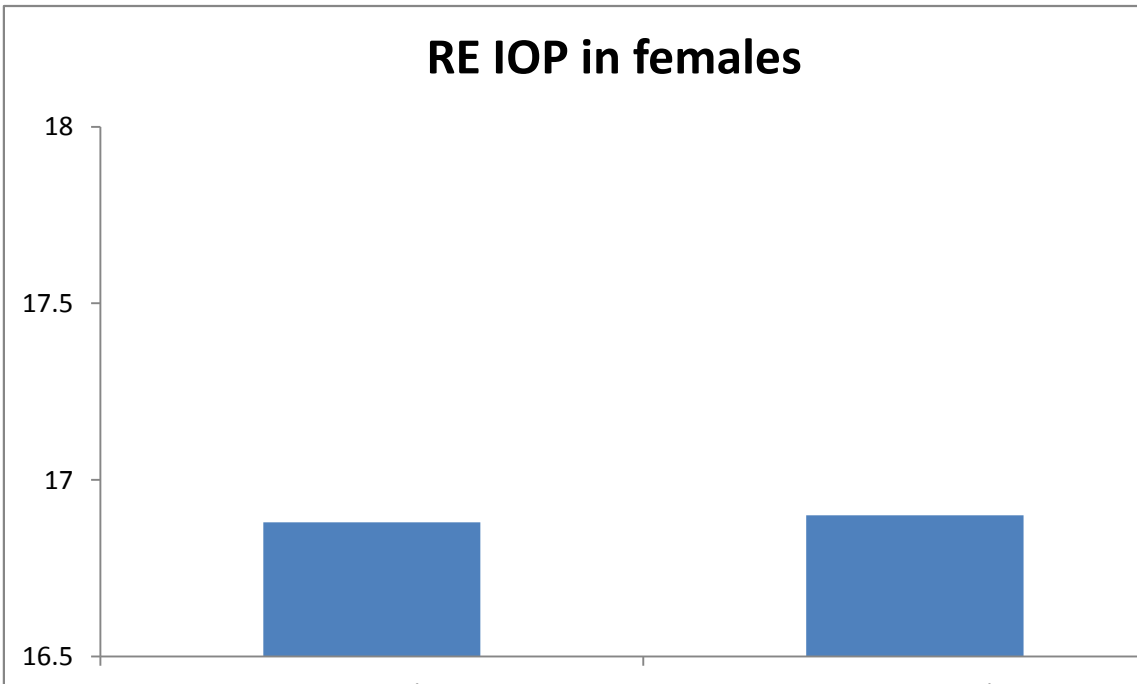


Table 16: Comparison of IOP (left eye) in females among exposed and non-exposed group:

FEMALES	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP(left eye)	16.24	1.84	16.15	3.02	0.677

IOP in the left eye in females was higher in the exposed group compared to the non-exposed group, and it was not statistically significant.

Graph 21: Bar diagram showing comparison of IOP (left eye) in females:

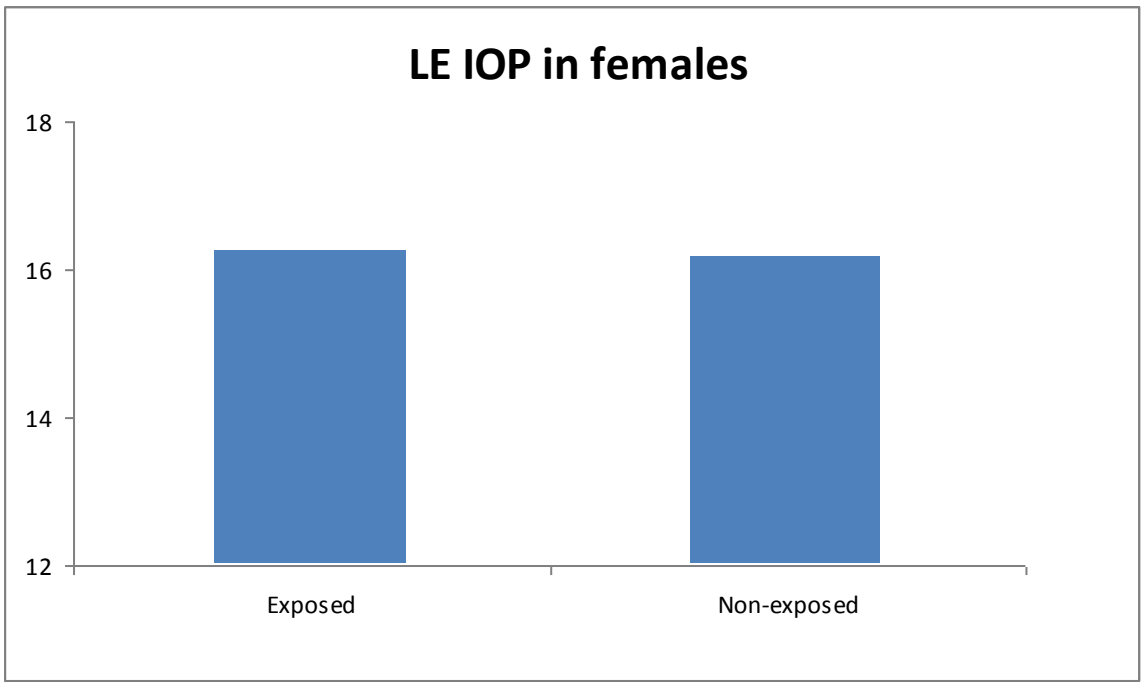


Table 17: Comparison of IOP (right eye) in males among exposed and non-exposed group:

MALES	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP(right eye)	16.37	2.55	18.29	3.16	0.062

IOP in the right eye in males was lower in the exposed group compared to the non-exposed group, but it was not statistically significant.

Graph 22: Bar diagram showing comparison of RE IOP in males:

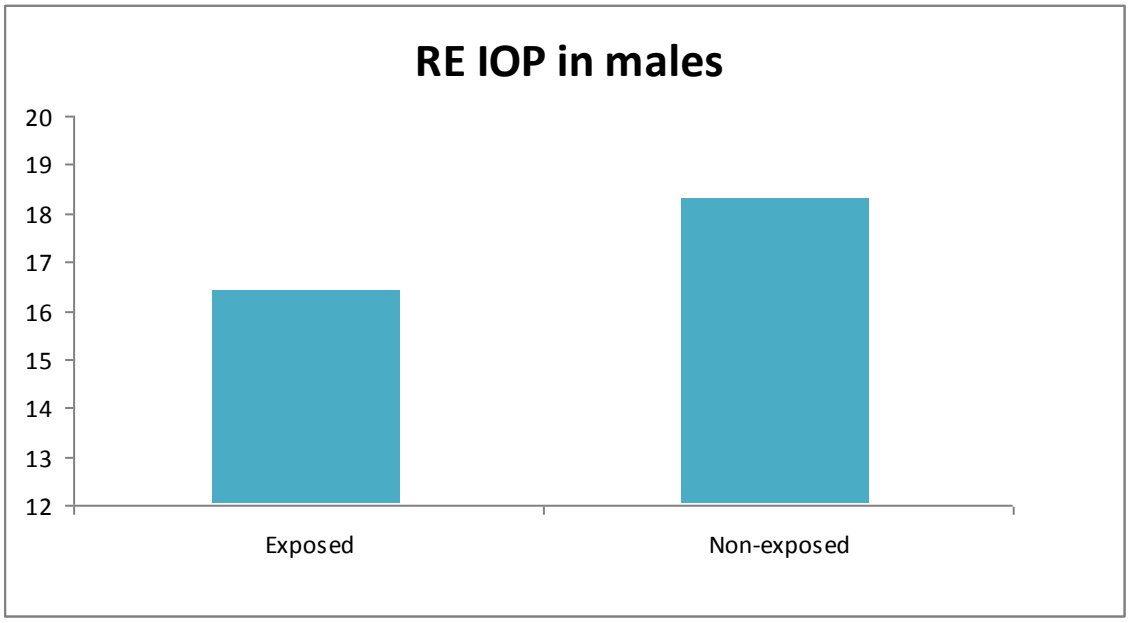


Table 18: Comparison of IOP (left eye) in males among exposed and non-exposed group:

MALES	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP (left eye)	16.46	2.63	17.83	3.11	0.255

IOP in the left eye in males was lower in the exposed group compared to the non-exposed group, but it was not statistically significant.

Graph 23: Bar diagram showing comparison of IOP (right eye) among exposed and non-exposed group:

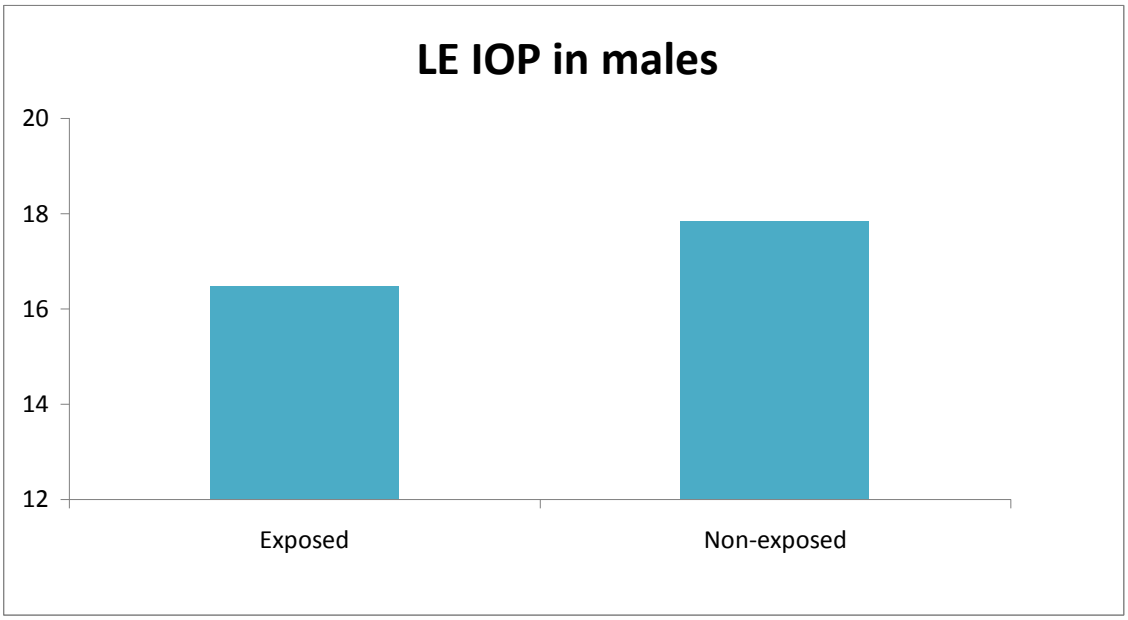


Table 19: Comparison of OPA (both eyes) among exposed and non-exposed group with systolic BP ≤ 120 mm Hg:

SYSTOLIC BP ≤ 120	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
OPA(both eyes)	2.15	0.93	2.57	0.78	0.012

OPA in both eyes among exposed group with Systolic BP ≤ 120 mm Hg was lower than those among the non-exposed group and it was statistically significant.

Graph 24: Bar diagram showing comparison of OPA (both eyes) with BP ≤ 120 mm Hg:

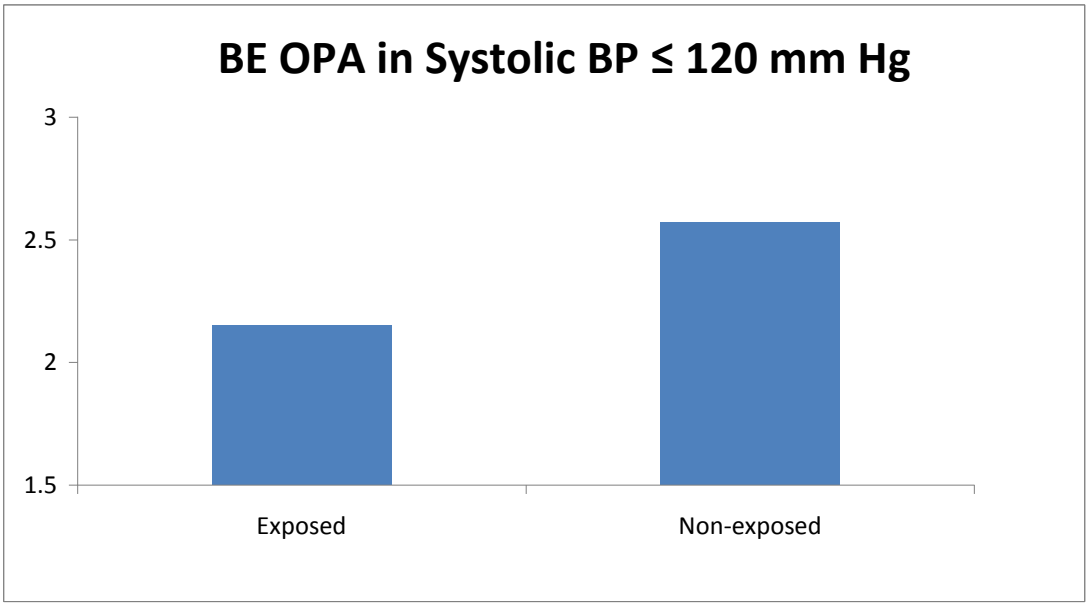
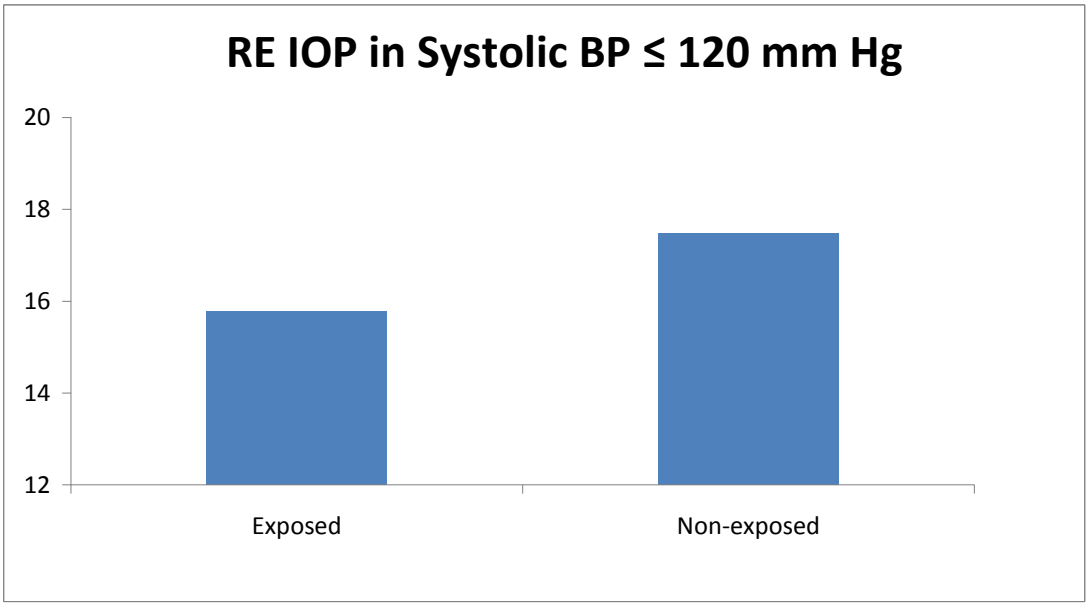


Table 20: Comparison of IOP (right eye) among exposed and non-exposed group with systolic BP ≤ 120 mm Hg:

SYSTOLIC BP ≤ 120	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP (right eye)	15.79	1.73	17.47	3.09	0.177

IOP in the right eye among exposed group with systolic BP ≤ 120 mm Hg was lower than those among the non-exposed group, but it was not statistically significant.

Graph 25: Bar diagram showing comparison of IOP (right eye) with BP ≤ 120 mm Hg:

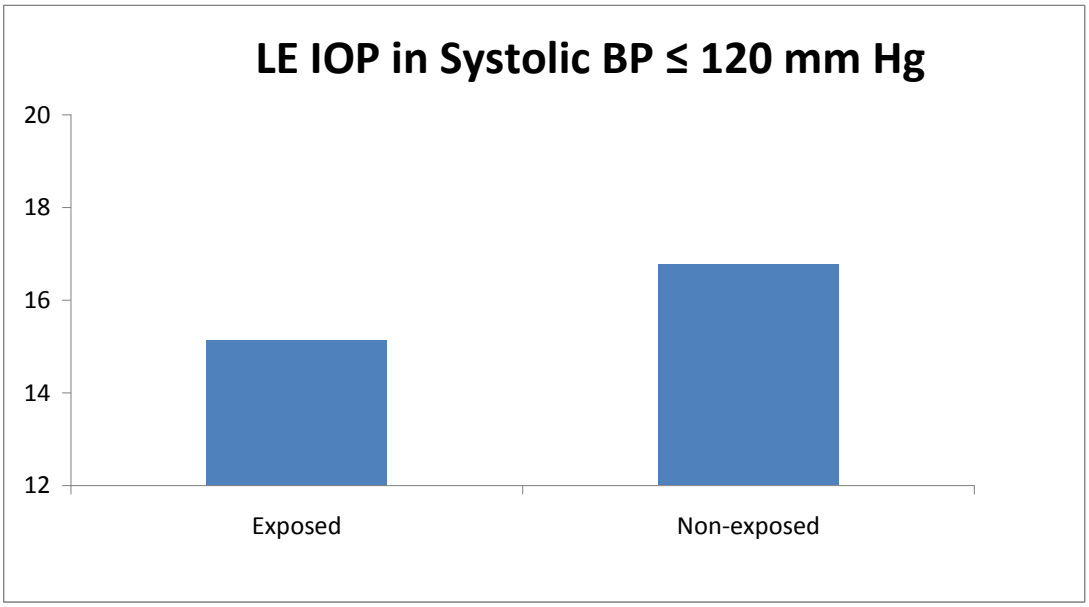


IOP in the left eye among exposed group with Systolic BP ≤ 120 mm Hg was lower than those among the non-exposed group, but it was not statistically significant.

Table 21: Comparison of IOP (left eye) among exposed and non-exposed group with systolic BP ≤ 120 mm Hg:

SYSTOLIC BP ≤ 120	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP(left eye)	15.13	1.83	16.76	3.48	0.198

Graph 26: Bar diagram showing comparison of IOP (left eye) with BP ≤ 120 mm Hg:



We could not compare OPA or IOP among exposed and non-exposed with systolic BP > 120 mm Hg as non-exposed group comprised of those with systolic BP ≤ 120 mm Hg.

Table 22: Comparison of OPA (both eyes) among exposed and non-exposed group with diastolic BP ≤ 80 mm Hg:

DIASTOLIC BP ≤ 80	EXPOSED		NON-EXPOSED		PVALUE
	MEAN	SD	MEAN	SD	
OPA(both eyes)	1.57	0.63	2.69	0.94	0.012

OPA in both eyes among exposed group with diastolic BP ≤ 80 mm Hg was lower than those among the non-exposed group and it was statistically significant.

Graph 27: Bar diagram showing comparison of OPA (both eyes) with BP ≤ 80 mm Hg:

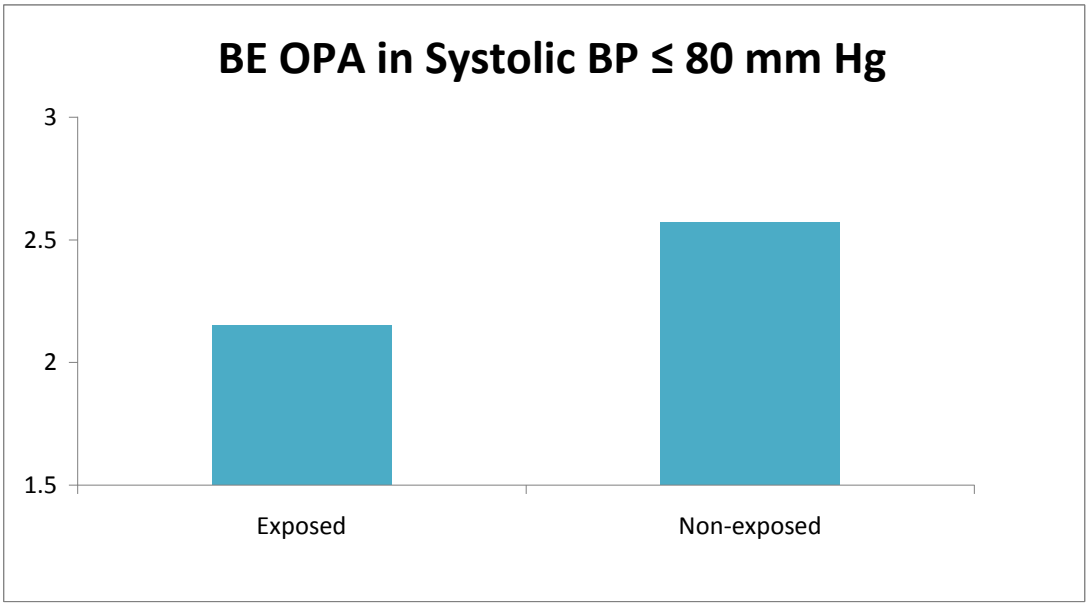


Table 23: Comparison of IOP (right eye) among exposed and non-exposed group with diastolic BP ≤ 80 mm Hg:

DIASTOLIC BP ≤ 80	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP (right eye)	15.45	1.68	17.30	2.90	0.097

RE IOP among exposed group with Systolic BP ≤ 80 mm Hg was lower than those among the non-exposed group, but it was not statistically significant.

Graph 28: Bar diagram showing comparison of IOP (right eye) with BP ≤ 80 mm Hg:

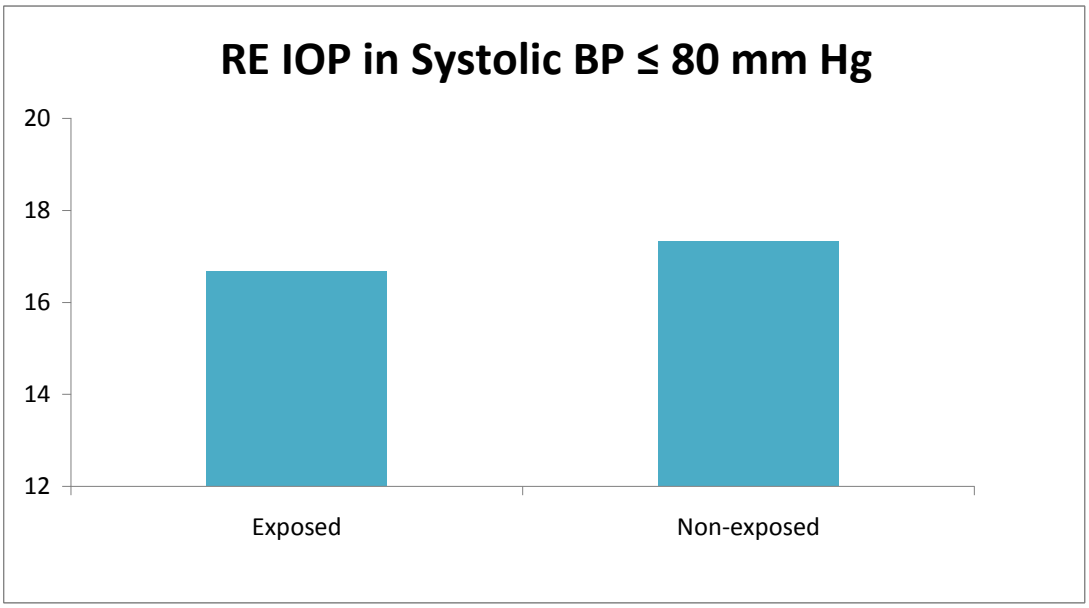
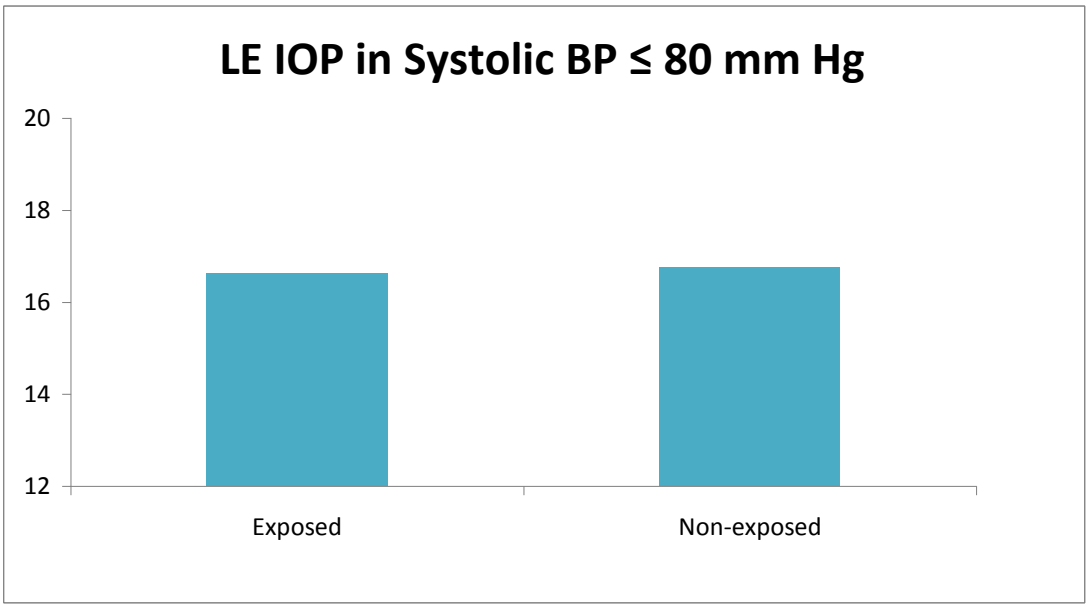


Table 24: Comparison of IOP (left eye) among exposed and non-exposed group with diastolic BP ≤ 80 mm Hg:

DIASTOLIC BP ≤ 80	EXPOSED		NON-EXPOSED		p VALUE
	MEAN	SD	MEAN	SD	
IOP (left eye)	14.51	2.10	16.51	3.29	0.097

IOP in the left eye among exposed group with Systolic BP ≤ 80 mm Hg was lower than those among the non-exposed group, but it was not statistically significant.

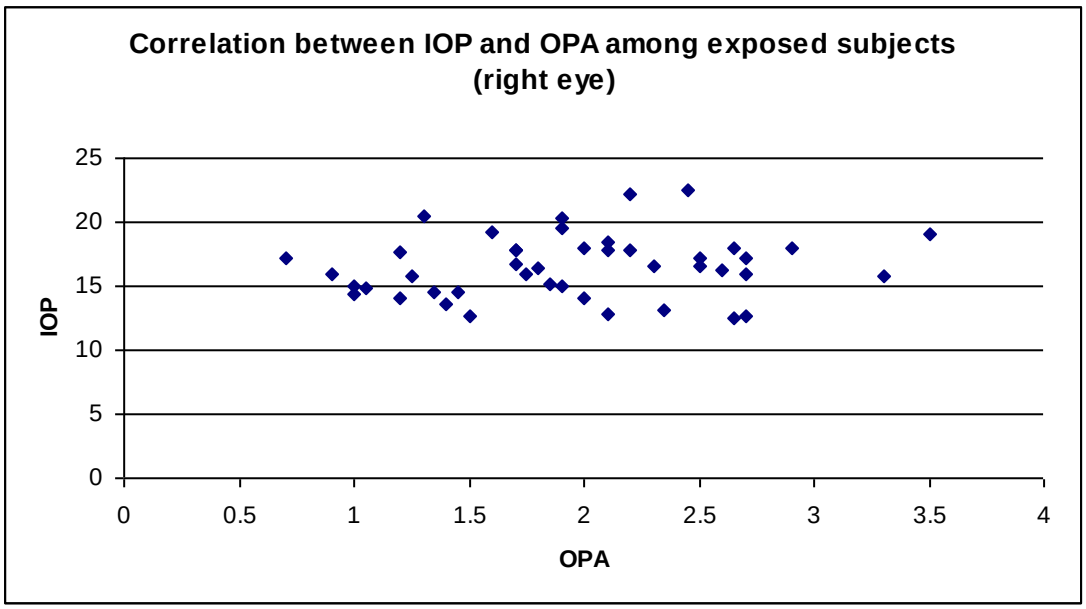
Graph 29: Bar diagram showing comparison of IOP (LE) with BP ≤ 80 mm Hg:



We could not compare OPA or IOP among exposed and non-exposed with diastolic BP > 80 mm Hg as non-exposed group comprised of those with diastolic BP ≤ 80 mm Hg.

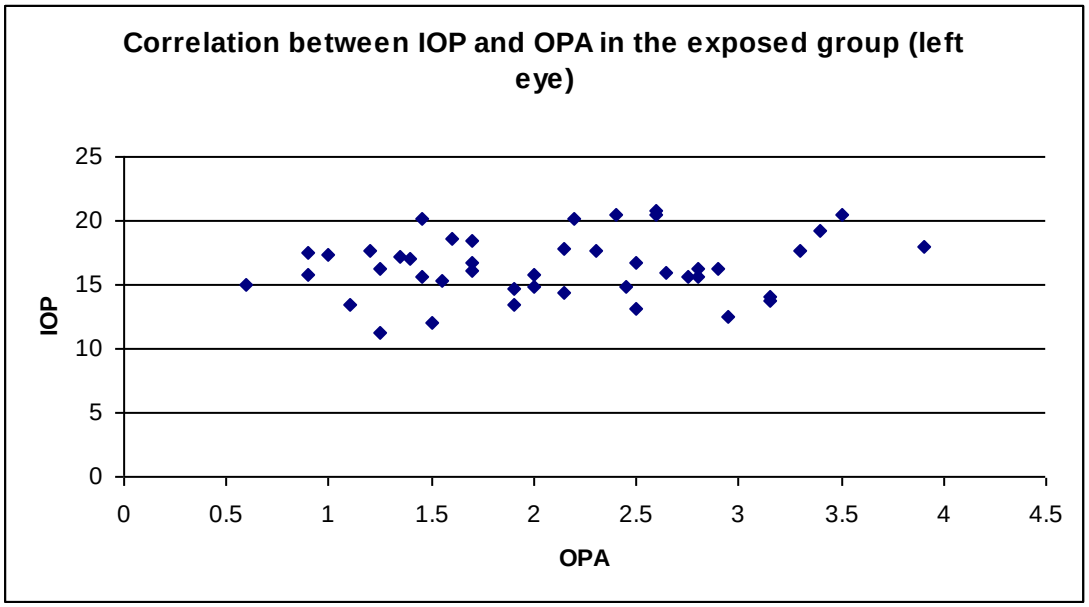
We compared IOP and OPA among exposed and non-exposed individuals and we found that there was no correlation between IOP and OPA in either group.

Graph 30: Correlation between IOP and OPA among exposed subjects in right eye:



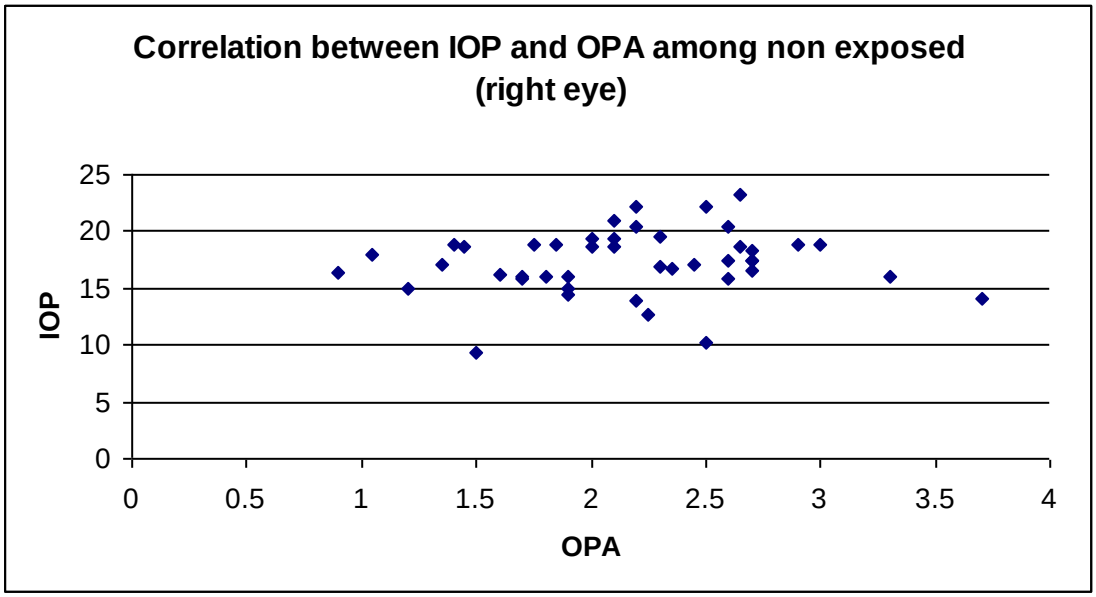
There was no correlation between IOP and OPA in the right eye among the non-exposed (r=0.16).

Graph 31: Correlation between IOP and OPA among exposed subjects in left eye:



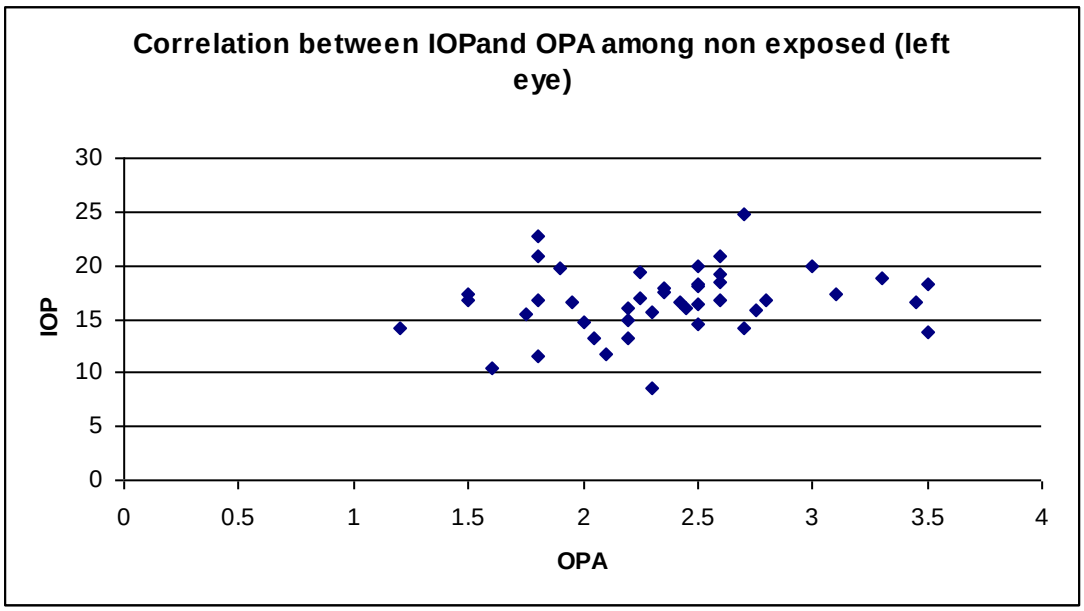
There was no correlation between IOP and OPA in the left eye among the non-exposed (r=0.17).

Graph 32: Correlation between IOP and OPA among non exposed subjects in the right eye:



No correlation existed between IOP and OPA in the right eye among the non-exposed (r=0.109).

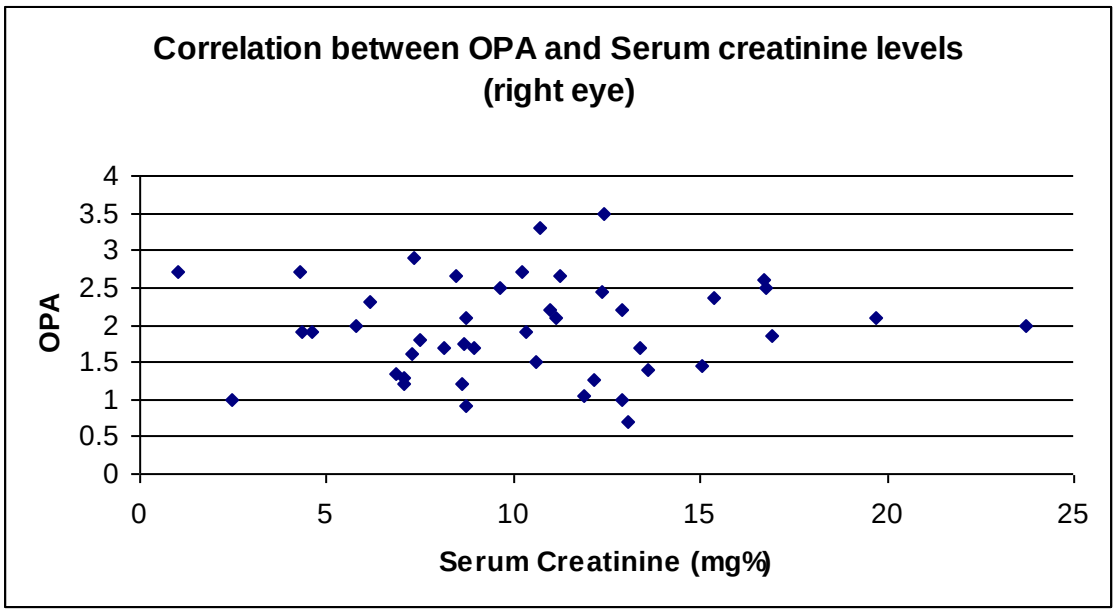
Graph 33: Correlation between IOP and OPA among non exposed subjects in left eye:



Between IOP and OPA in the left eye among the non-exposed also there was no correlation. (r=0.206).

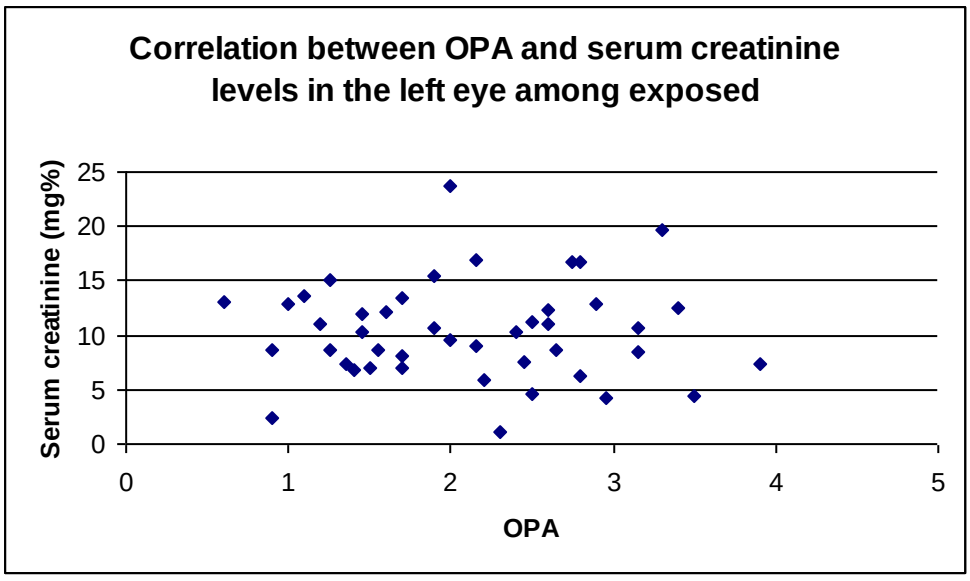
We compared OPA and IOP with Serum creatinine levels in both eyes in the exposed and non-exposed group, but there was no correlation in any of the group.

Graph 34: Correlation between OPA and Serum creatinine among exposed subjects in right eye:



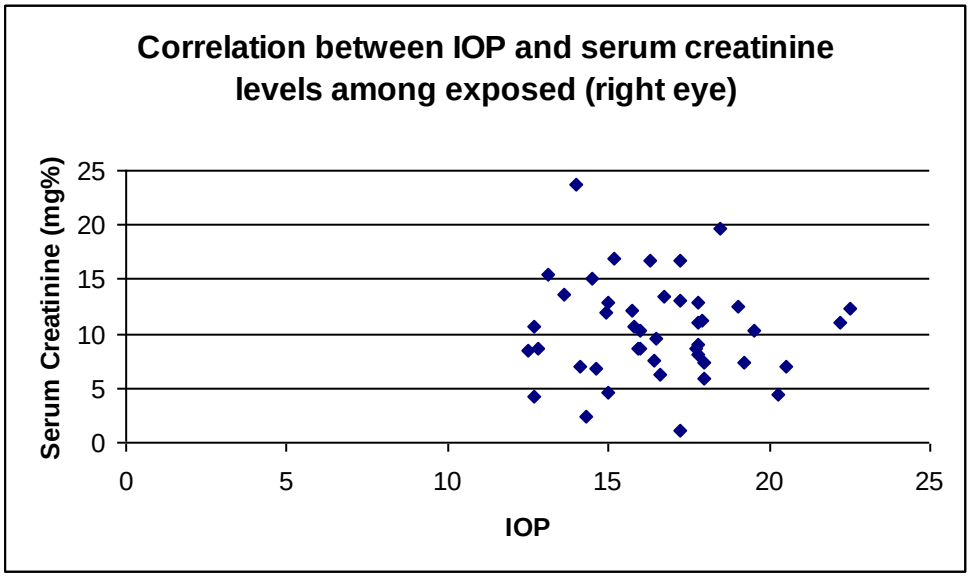
There was no correlation between OPA in the right eye and serum creatinine among the exposed (r=0.049).

Graph 35: Correlation between OPA and Serum creatinine among exposed subjects in left eye:



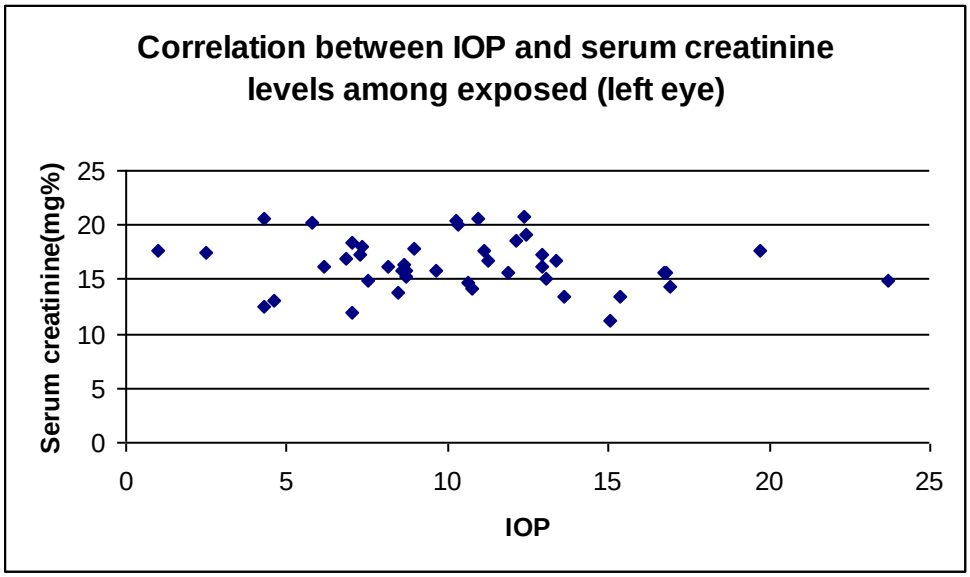
There was no correlation between OPA in the left eye and serum creatinine among the non-exposed (r = -0.0065).

Graph 36: Correlation between IOP and Serum creatinine among exposed subjects in right eye:



There was no correlation between IOP in the right eye and serum creatinine among the non-exposed (r = -0.055).

Graph 37: Correlation between IOP and Serum creatinine among exposed subjects in left eye:



There was no correlation between IOP in the left eye and serum creatinine among the non-exposed (r = -0.153).

DISCUSSION

Patients with end stage renal disease (ESRD) who are on hemodialysis are always at a risk of developing eye diseases. Choroidopathy is a main complication that occurs in these patients and the only method to study the severity of the disorders of the choroid is Indocyanine Green angiography (ICGA).Given the invasive nature of ICGA, it is life threatening and hence contraindicated in ESRD (51). Moreover to look for improvement in choroidal perfusion after renal transplant surgery, using this invasive procedure may not be advisable since ICG may be toxic to the donor kidney.

OPA is the fluctuation of IOP with heart rate and it is an indirect indicator of the choroidal perfusion. OPA can be measured with the help of Dynamic Contour Tonometer (DCT) which helps in the simultaneous recording of OPA and IOP. According to literature, normal OPA ranges from 1-3.4 mm Hg and there was positive correlation between OPA and IOP (36). Significant asymmetry of OPA has been documented in patients with vascular stenosis (15, 16) and arteriovenous fistulas and there was a significant increase in pulsatile ocular blood flow in those patients with moderate to severe NPDR (8, 9). Studies on diabetic retinopathy and ocular pulse amplitude have shown varying results. Hypertension and end stage renal diseases are associated with choroidopathy (20-21). However, no correlation between OPA and systemic or diastolic blood pressures or their amplitudes is reported in available literature (6).

We looked at OPA as a surrogate for ICGA to look at choroidal perfusion in patients with ESRD on hemodialysis and compared them with age matched normals. Till date there are no studies which have measured OPA in end stage renal disease. Hence we did a pilot study to see if there

is any difference in OPA between patients with ESRD and normals, which indicated that the OPA in patients with ESRD was significantly lower than normal individuals. We chose patients with ESRD with no diabetes to ensure that OPA is not affected by diabetes and retinopathy if any. Since the patients were undergoing hemodialysis their blood pressures were also normal.

Analyzing the OPA in the right and left eyes separately would ensure that measurement errors and biases are eliminated. 2 values of OPA with quality factor 2 or less also minimized errors in measurement. In both right and left eyes the OPA in patients with ESRD was statistically significantly lower than age matched normals. In the right eye the mean OPA was 1.945mm Hg (CI: 1.847 - 2.043) and 2.16mm Hg (CI: 2.08-2.24) in the ESRD group and normals respectively. There was a statistically significant difference between the 2 groups ($p = 0.03$). The fact that the confidence intervals do not overlap clearly indicates that there is a difference between the 2 groups. The mean OPA in the exposed group and non exposed groups in the left eye were also statistically significantly different ($p = 0.02$).

Similar to the study by Purjavan et al., (36) there was a very strong positive correlation (Pearson's correlation coefficient $r= 0.79$) between OPA in the right and left eyes in patients with ESRD thus showing that both eyes have similar OPA ($p=0.03$). Similar correlation existed between IOP ($r=0.74$) in both eyes in patients with ESRD.

Studies by Kaufmann et al., (2) Stalmans et al., (27) and Purjavan et al., (36) found positive correlation between OPA and IOP as measured using DCT in normal subjects. However in our study we found no correlation between OPA and IOP using DCT in patients with ESRD as well as normal subjects.

With the assumption that age related changes in the choroidal blood flow can affect the OPA we divided the patients into those who were 30 years or less and those more than 30 years. 30 years being the median age, was chosen as the cut off. The reason for this assessment was to see if ESRD related choroidal changes not affected by age will show a greater difference in OPA compared to normals. With age considered as a confounding factor we assumed a considerable difference in OPA between exposed and non exposed patients in the younger subset of patients, which would compensate even when our sample size was halved. Age however, did not seem to account for changes in OPA in patients with ESRD. Thus aging and related choroidal changes do not seem to affect the ocular pulse amplitude as measured using DCT though one needs to look at this finding critically after increasing the sample size.

From our study it is reasonably clear that ocular pulse amplitude is statistically significantly lower in patients with end stage renal disease suggesting significant choroidopathy in these patients. The patients recruited for our study were those undergoing hemodialysis and hence had normal blood pressure at the time of measuring OPA. Therefore the influence of high blood pressure on OPA could not be studied. The OPA would probably have been lower if we had recruited patients who were not on dialysis or if these measurements were taken just before the dialysis and compared with the values of the OPA after dialysis. This probably would have given us a better insight into the ocular blood flow in these patients. However, this was not within the scope of our study.

In this study we postulate that measurement of OPA can be used as an alternative, simple noninvasive test to assess the choroidal perfusion in patients with end stage renal disease. In patients with ESRD on dialysis we found decreased OPA indicating decreased choroidal perfusion in ESRD. Following up and measuring the OPA in patients with ESRD prior to

dialysis, immediately after dialysis and after renal transplantation would help us understand the changes in OPA and choroidal perfusion with treatment. This knowledge may also help us use OPA as a tool to detect the success of renal transplantation as it could potentially improve choroidal perfusion.

In addition, subsequent studies on subjects with early nephropathy may give us a clue as to whether OPA measurement can be used for early detection of nephropathy which can go undetected especially in those with no hypertensive retinopathy.

LIMITATIONS

1. All patients had normal blood pressure at the time of measuring OPA. We could have recruited another set of 44 patients with hypertension but no renal disease.

2. Measuring OPA in patients before and after dialysis would have given a true picture of the influence if any of dialysis on the OPA.

3. Doubling the sample size would have been helpful in detecting the effect of age on measured OPA.

CONCLUSIONS

- The mean OPA in non diabetic patients with end stage kidney disease was 1.945mm Hg (CI: 1.847 - 2.043).
- The mean OPA in age matched normals was 2.16mm Hg (CI: 2.08-2.24)
- The OPA in non diabetic patients with end stage renal disease was statistically significantly lower than that of age matched normals (p=0.03).
- There was no correlation between OPA and other parameters age, gender or intraocular pressure.
- There was no correlation between OPA and blood pressure or serum creatinine levels

BIBLIOGRAPHY

1) Pascal B. Knecht, Moreno Menghini, Lucas M. Bachmann, Ralf W. Baumgartner, Klara Landau The Ocular Pulse Amplitude as a Noninvasive Parameter for Carotid Artery Stenosis Screening: A Test Accuracy Study; doi:10.1016/j.ophtha.2011.12.040
2) Kaufmann C, Bachmann LM, Robert YC, et al. Ocular pulse amplitude in healthy subjects as measured by dynamic contour tonometry. Arch Ophthalmol. 2006; 124: 1104-08.
3) Harris A, Vanbellighen V, Zeyen T et al. Ocular pulse amplitude in Normal tension and Primary open angle glaucoma. J Glaucoma 2008 Aug; 17(s): 403-7.
4) Kawabata K, Kimura T, Fujiki K et al. Ocular pulse amplitude in patients with Open angle glaucoma, Normal tension glaucoma, and Ocular hypertension by dynamic observing tonometry. Nippon Ganka Zasshi 2007 Dec, 111(12): 946-52.
5) O Schwenn, R Troost, A Vogel, et al. Ocular pulse amplitude in patients with Open angle glaucoma, normal tension glaucoma, and ocular hypertension. Br J Ophthalmol 2002; 86:981–984.
6) Grieshaber MC, Katamay R, Gugleta K et al. Relationship between Ocular pulse Amplitude and systemic blood pressure measurements; Acta Ophthalmol 2008 Oct13.
7) Trew DR, James CB, Thomas SH et al. Factors influencing ocular pulse: the heart rate. Graefes; Arch Clin Exp Ophthalmol. 1991: 229:553-556.
8) Golnik KC, Miller NR. Diagnosis of cavernous sinus arteriovenous fistula by measurement of Ocular pulse amplitude. Ophthalmology, 1992;99:1146-52.
9) Kaufmann C, Thiel MA, Valavanis A et al. Normalization of ocular pulse amplitude after embolization of dural cavernous sinus arterivenous fistula. Klin Monatsbi Augenheilkd 2004;221:431-4.

10) Ito YN, Mori K et al. Aging changes of the choroidal dye filling pattern in indocyanine green angiography of normal subjects. Retina 2001; 21(3): 237-42.

11) Utsugi N, Takahashi K, Kishi S. Choroidal vascular occlusion in internal carotid artery obstruction. Retina 2004 Dec; 24(6): 915-9.

12) Ivert L, Kong J, Gouras P Alteration in choroidal blood flow produced by local pressure. Graffe Arch Clin Exp Ophthalmol 2006 Oct; 244(10):1339-44. Epub 2006 Mar 17.

13) Thomas. A. Ciulla, Alon Harris et al. Ocular perfusion abnormalities in diabetes. Acta Ophthalmologica Scandinavica. October 2002; Vol 80; Issue 5; Pages 468-477.

14) D. Scott Mc Leod, Gerard A. Lutty. High resolution histologic analysis of the human choroidal vasculature. IOVS October 1994, Vol35; No 11.

15) Perkins ES. The Ocular pulse and intraocular pressure as a screening test for carotid artery stenosis. Br J Ophthalmol1985; 69:676-80.

16) G J Klein, R H Boumgartner et al. An image processing approach to characterizing choroidal blood flow. IOVS 1990; 31(4); 629-37.

17) Niutta A, Spicci D, Barcaroli I. Ann Ophthalmol. 1993 Oct; 25(10):375-80. Fluoroangiographic findings in hemodialyzed patients.

18) Hassenstein A, Scholz F, Richard G. The new OCT generation offers deep insights: imaging of the choroid using the Cirrus OCT. Ophthalmology 2013 Mar; 110(3): 239-46.

19) Sun H, Frassetto L, Benet LZ. Effects of renal failure on drug transport and metabolism. Pharmacology Ther2006 Jan; 109(1-2): 1-11. Epub 2005 Aug 8.

20) S Chatterjee, S Chattopadhya et al. Hypertension and the eye: changing prospective. Journal of human hypertension. October 2002, Vol 16, No 10, Pg 667-675.

21) Nirav V Kamdar, Amsalu Erko et al. Choroidopathy and kidney disease: a case report and review of literature. Cases Journal. 2009; 2: 7425.

22) Min Kim, Sun Soo Kim et al. Association between choroidal thickness and ocular perfusion pressure in young healthy subjects: enhanced depth imaging optical coherence study. IOVS Nov 2012; Vol 53; No 12.

23) Yingfeng Zheng, Tien Y. Wong et al. Distribution of ocular perfusion pressure and its relationship with open angle glaucoma: The Singapore Malay eye study. IOVS July 2010; Vol 51; No 7

24) Kawabata K, Kimura T, Fujiki K et al. Ocular pulse amplitude in patients with Open angle glaucoma, Normal tension glaucoma, and Ocular hypertension by dynamic observing tonometry. Nippon Ganka Zasshi 2007 Dec, 111(12): 946-52.

25) Punjabi OS, Ho HK, Kniestedt C, et al. Intraocular pressure and ocular pulse amplitude comparisons in different types of glaucoma using dynamic contour tonometry. Curr Eye Res. 2006 Oct; 31(10):851-62.

26) Marvin Lee, Eun-Hyung Cho et al. Relationship Between Ocular Pulse Amplitude and Glaucomatous Central Visual Field Defect in Normal-tension Glaucoma. Journal of Glaucoma 2012; 21: 596-600.

27) Stalmans I, Harris A, Vanbellinghen V, et al. Ocular pulse amplitude in normal tension and primary open angle glaucoma. J Glaucoma. 2008; 17:403–407.

28) J. W. Kiel, W. A. J. Van heuven. Ocular perfusion pressure and choroidal blood flow in the rabbit. IOVS March 1995; Vol 36; No 3.

29) Kaufman C, Fierz A, Kollias SS et al. Ocular pulse amplitude in case of innominate steal syndrome. Am J Ophthalmol 2002; 133:155- 6.

30) Thomas A Ciulla, Alon Harris, Larry Kagemann, Ronald P Danis et al. Choroidal perfusion perturbations in non-neovascular age related macular degeneration. Br J Ophthalmol 2002; 86: 209–213.

31) Kniestedt C, Lin S, Choe J et al. Clinical comparison of contour and applanation tonometry and their relationship to pachymetry. Arch Ophthalmol 2005; 123: 1532-7.

32) Breusegem C, Fieuws S, Zeyen T et al. The effect of trabeculectomy on OPA. Tnv Ophthalmol Vic Sci 2010; 51:231-235.

33) Sandra R, Von Schultus, Claude Kaufmann et al. Ocular pulse amplitude after trabeculectomy. Graefe's Arch Clin & Exp Ophthalmol 2006, 244: 46-51.

34) Von Schulthess SR, Kauffmann C, Bachmann LM ea al. Ocular pulse amplitude after trabeculectomy. Graefes Arch Cli Exp Ophthalmol 2006 Jan 244(1):46-51.

35) Hoffman EM, Grus FH, Pfieffer N. Intraocular pressure and ocular pulse Amplitude using dynamic contour tonometry and contact lens tonometry. BMC Ophthalmology 2004, 4:4.

36) Pourjavan S, Boelle PY, Detry-Morel M, De Potter P. Physiological diurnal variation and characteristics of the Ocular Pulse Amplitude with Dynamic Contour Tonometer. International Ophthalmology. 2007 Dec 27(6); 357-60.

37) Savage HI, Hendrix JW, Peterson DC et al. Differences in pulsatile ocular blood flow among three classifications of diabetic retinopathy. Invest Ophthalmol Vis Sci 2004 Dec 45(12):4504-9.

38) Geyer O, Newdorfer M, Snir T et al. Pulsatile ocular blood flow in diabetic retinopathy. Acta Ophthalmol Scan 1999 Oct 77(5) 522-5.

39) Mc Kinnon JR, O'Brein C, Swa K et al. Pulsatile ocular blood flow in untreated diabetic retinopathy. Acta Ophthalmol Scan 1999 Dec 75(6)661-4.

40) Langham ME, Grebe R, Hopkins S et al. Choroidal blood flow in diabetic retinopathy. Exp Eye Res 1991 Feb 52 (2) 167-73.

41) T. Nagaoka, N. Kitaya et al. Alteration of choroidal circulation in the foveal region in patients with type 2 diabetes. BJO 2004 August; 88(8): 1060-1063.

42) Omar S Punjabi, Christoph Kniestedt et al. Dynamic contour tonometry: principle & use. Clinical & Experimental Ophthalmology 2006; 34: 837-840.

43) Fatmire Berisha, Oliver Findl et al. A study comparing ocular pressure pulse and ocular fundus pulse in dependence of axial eye length and ocular volume. Acta Ophthalmologica 2010; 88; 766-772.

44) A summary of safety and effectiveness of blood flow analyzer. October 2002; K023245.

45) Hartmut E. Kanngiesser, Christoph Kniestedt et al. Dynamic Contour Tonometry, Presentation of a New Tonometer. J Glaucoma 2005; 14: 344-350.

46) Kniestedt C, Nee M, Stamper RL. Dynamic contour tonometry: a comparative study on human cadaver eyes. Arch Ophthalmol 2004; 122: 1287-1293.

47) Kniestedt C, Nee M, Stamper RL. Accuracy of Dynamic contour tonometry compared with applanation tonometry in human cadaver eyes of different hydration states. Graefes Arch Clin Exp Ophthalmol.2005; 243:359-366.

48) Yun HM, Fu P, Yuan JS, Zhang B, Li XX et al. Diurnal variation curve of intraocular pressure and ocular pulse amplitude with dynamic contour tonometer in primary open-angle glaucoma and normal tension glaucoma patients. Zhonghua Yi Xue Za Zhi. 2006 Dec 26; 86(48):3401-4.

49) M Deytry-Morel, J Jamart, M B Detry, et al. Clinical evaluation of Pascal Dynamic contour tonometer. J Fr Ophthalmol 2007, 30; 3:260-270.

50) Sarah L Owens; Indocyanine green angiography. BJO; 1996; Vol 80; 263-266.

51) Rosario Brancato and Giuseppe Trabucchi. Fluorescein and Indocyanine Green Angiography in Vascular Chorioretinal Diseases. Seminars in Ophtbalmology,Voll3, No 4 December, 1998: pp 189-198

52) T. Desmettre, J. M. Devoiselle et al; Fluorescence properties and metabolic features of ICG as related to angiography; Survey of Ophthalmology; Vol 45; Issue 1; July 2000; Pages 15-27.

53) Bischoff PM, Flower RW. Ten years experience with choroidal angiography using indocyanine green dye: a new routine examination or an epilogue? Doc Ophthalmol 1985; 60: 235-91.

54) Destro M, F'uliafito CA. Indocyanine green video angiography of choroidal neovascularization. Ophthalmology. 1989; 96: 846.

55) Flower RW. Choroidal angiography today and tomorrow (editorial). Retina. 1992; 12:189.

56) William R. Freeman, Dirk-Uwe Bartsch et al. Simultaneous Indocyanine Green and Fluorescein Angiography Using a Confocal Scanning Laser Ophthalmoscope. Archives of Ophthalmology. 1998; 116(4): 455-463.

57) KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease; Official journal of the international society of Nephrology; Vol 3; 5-14; Issue 1; January 2013.

58) Gaia Mullaem, Mitchell H. Rosner Seminars in dialysis. Ocular problems in patients with end stage renal diseases. Vol 25; No 4; July-August 2012.

59) Levy J, Tovbin D, Lifshitz T, Zlotnik M, Tessler Z: Intraocular pressure during haemodialysis: a review. Eye 19:1249–1256, 2005.

60) Tobvin D, Belfair N et al: High post dialysis urea rebound can predict intradialytic increase in IOP in dialysis patients with lowered intradialytic hemoconcentration. Nephron 2002; 90: 181-187.

61) Nongpiur MD, Wong TY, Sabanayagam C, Lim SC, Tai ES, Aung T: Chronic kidney disease and intraocular pressure, The Singapore Malay Eye Study. Ophthalmology 2010; 117(3):477–483.

62) Hojs R, Pahor D: Intraocular pressure in chronic renal failure patients treated with maintenance hemodialysis. Ophthalmologica 211:325–326, 1997.

63) De Marchi S, Cecchin E et al. IOP changes during hemodialysis: prevention of excessive dialytic rise and development of severe metabolic acidosis following acetazolamide therapy. Ren Fail. 1989; 11 (2-3); 117-24.

64) Tokuyama T, Ikeda T, Sato K et al. Effect of plasma colloid osmotic pressure on intraocular pressure during hemodialysis. Br J Ophthalmol; 82:751–753, 1998.

65) Klaassen-Broekema N, van Bijsterveld OP. Red eyes in renal failure. Br J Ophthalmol 76:268–271, 1992.

66) Aktas Z, Ozdek S, Asli Dinc U et al. Alterations in ocular surface and corneal thickness in relation to metabolic control in patients with chronic renal failure. Nephrology12:380–385, 2007.

67) Resnde LAL, Caramori JC et al. Blink reflex in end stage renal disease patients undergoing hemodialysis. J Electromyogr Kinesiol. 12:159–163, 2002.

68) Caldeira JAF, Sabbaga E, Ianhez LE et al. Conjunctival and corneal changes in renal failure. Br J Ophthalmol 54:399–404, 1970.

69) Angra SK, Goyal JL: Haemodialysis cataract. Indian J Ophthalmol. 35(2):82–83, 1987.

70) Basu S, Das T, Padhi TR et al. Serous retinal detachment and multiple retinal pigment epithelial detachments, following hemodialysis for multiorgan failure. Indian J Ophthalmol 58(3):261–262, 2010.

71) Troiano P, Buccianti G: Bilateral symmetric retinal detachment and multiple retinal pigment epithelial detachments during haemodialysis. Nephrology Dial Transplant 13:2135–2137, 1998.

72) Theodossiadis PG, Theodoropoulou S, Neamonitou G et al. Hemodialysis- induced alterations in macular thickness measured by optical coherence tomography in diabetic patients with end-stage renal disease. Ophthalmologica 227(2):90–94, 2012.

73) Winkelmayer WC, Eigner M, Berger O et al. Optic neuropathy in uremia: an interdisciplinary emergency. Am J Kidney Disease 37(3):E23, 2001.

74) Bixia Gao, Ling Zhu, Yingzi Pan, Shuwen Yang et al. Ocular fundus pathology and chronic kidney disease in a Chinese population. BMC Nephrology 2011, 12:62.

75) M. Easterbrook and C. B. Mortimer; Ocular signs in chronic renal failure. British journal of Ophthal. (I970) 54, 724.

76) Executive summary: Standards of medical care in diabetes-2013. Diabetes care. January 2013. Volume 36. Supplement 1

APPENDIX I

CLINICAL PROFORMA

Study no				
Exposed / non exposed group				
Date of Enrollment				
Name				
Age				
Schell Eye Hospital No				
CMC Hospital No				
Address				
Contact No				
Date of Examination				
Blood Pressure				
AC				
Creatinine				
DCT – Recording	**RE OPA**	**RE IOP**	**LE OPA**	**LE IOP**
DCT – 1st reading				
DCT – QF (1st reading)				
DCT – 2nd reading				

APPENDIX II

PATIENT INFORMATION SHEET IN ENGLISH

Christian Medical College, Vellore

Department of Ophthalmology

Ocular Pulse Amplitude in non Diabetic patients with end stage renal disease on dialysis and normal individuals using Dynamic Contour Tonometry-A Cross sectional Study

Patient Information sheet

You are being requested to participate in a study to see the difference in measurement of Ocular Pulse Amplitude (OPA) in patients with renal disease on dialysis and normal individuals with an instrument called Dynamic Contour Tonometer (DCT). This instrument is used to measure the intraocular pressure (IOP) which is important in the diagnosis of a blinding disease called glaucoma. Along with measuring IOP, DCT also measures OPA. We hope to include about 88 patients (44 with kidney disease and 44 with no kidney disease) from this hospital for this study.

What are OPA and DCT?

OPA is an indirect indicator of the blood supply to the eye especially the choroidal blood vessels, which helps in the nutrition of the retina. The retina is the light sensitive part of the eye. Choroidal perfusion is decreased in patients with kidney disease. Indocyanine Green Angiography has been used to look at choroidal perfusion in these patients earlier. But this is an invasive procedure, which requires injecting a dye in to the body and taking pictures of the eye. This dye is toxic to the kidneys and is definitely not preferred in patients who have kidney disease. Measurement of OPA using DCT is a non-invasive procedure which only requires a topical anesthetic to be instilled in the eye.

Does the test have any side effects?

No. There are no significant side effects for this test.

If you take part what will you have to do?

If you agree to participate in this study, you have to come for a complete ophthalmic examination including OPA measurement using DCT. This will be like any routine eye examination and does not take any extra time.

Can you withdraw from this study after it starts?

Your participation in this study is voluntary. Not giving consent for participation in the study will not affect your treatment in this hospital.

What will happen if you develop any study related injury?

This procedure is not likely to have any ocular injuries.

Will you have to pay for the test?

No payment is required for the tests done for the study.

What happens after the study is over?

After the study is over the results of the study will be published in scientific journals. The names or identity of any of the participants will not be published. The hospital records will be kept in the Dept of Ophthalmology. Interested patients can be briefed about the results of the study.

Will your personal details be kept confidential?

The results of this study will be published in a medical journal but you will not be identified by name in any publication or presentation of results. However, your medical notes may be reviewed by people associated with the study, without your additional permission, should you decide to participate in this study.

CONSENT FORM IN ENGLISH

CONSENT TO TAKE PART IN A CLINICAL TRIAL

Study Title: Ocular Pulse Amplitude in non Diabetic patients with end stage renal disease on dialysis and normal individuals using Dynamic Contour Tonometry-A Cross sectional Study

Study Number:

Participant's name:

Hospital no:

Date of Birth / Age (in years):

I_____,

Son/daughter of _____

(Please tick boxes)

- Declare that I have read the information sheet provide to me regarding this study and have clarified any doubts that I had. [ ]
- I also understand that my participation in this study is entirely voluntary and that I am free to withdraw permission to continue to participate at any time without affecting my usual treatment or my legal rights [ ]
- I also understand that the test will be done free of cost [ ]

- I understand that the study staff and institutional ethics committee members will not need my permission to look at my health records even if I withdraw from the trial. I agree to this access [ ]
- I understand that my identity will not be revealed in any information released to third parties or when the results are published [ ]
- I voluntarily agree to take part in this study [ ]

Name:

Signature/Thumb impression:

Date:

Name of witness:

Relation to participant:

Date:

PATIENT INFORMATION SHEET IN TAMIL

TAMIL

தகவல் பிரதி

கண்ணின் விழி துடிப்பு வீச்சை (Ocular Pulse Amplitude) டைனமிக் காண்டர் போனோமெட்ரி (DCT)யைக் கொண்டு நீரிழிவு நோய் அல்லாத மற்றும் சிறுநீரக நோய்களால் பாதிப்புள்ளவர்கள் பயன்படுத்தி அறியப்படும் ஆய்வு.

இந்த ஆய்வில் மொத்தம் 88 பேர் பயன்படுத்தப்படுவாகிள் (இதில் 44 பேர் சிறுநீரக நோயினால் பாதிக்கப்பட்டவர்களும் 44 பேர் சிறுநீரக நோயால் பாதிக்கப்படாதவர்களும் அடங்குவர்). **நீங்கள் இந்த ஆய்வில் பங்குபெறும் பட்சத்தில்** உங்கள் கண்ணின் விழி துடிப்பு வீச்சை (Ocular Pulse Amplitude) டைனமிக் காண்டர் போனோ மீட்டர் (Dynamic Contour Tonometer) மூலமாக அளவிடமுடியும். மேலும் இந்த கருவி கண் அழுத்த நோய் உள்ளவர்களின் கண் உள் அழுத்த அளவை அளப்பதற்கும் பயன்படுகிறது.

கண்ணில் உள்ள விழித்திரை (Retina) என்பது மிகவும் மென்மையான உறுப்பாகும். இந்த உறுப்பு சரியாக இயங்க வேண்டுமானால் கருவிழி படல இரத்த நாளங்களில் (Choroidal Blood -Vessels) பாதிப்பு இல்லாமல் இருக்க வேண்டும். ஆனால் சிறுநீரக வியாதி உள்ளவர்களுக்கு இரத்த நாளங்களில் சிறிதளவு பாதிப்பு இருக்கும். எனவே எந்த அளவுக்கு பாதிப்பு உள்ளது என்பதை விழி துடிப்பு வீச்சை கண்டறிவதன் மூலம் அறியலாம். வழக்கமாக இன்போ சயனைன் கீரீன் ஏஞ்சியோகிராபி (Indocyanine Green or ICG Angiography) என்ற முறையில் உடலில் எந்தவித கீறலும் இல்லாமல் சாய ஊசி மூலம் உடலுக்கு செலுத்தி படங்கள்பிடித்து அறிந்து கொள்ளலாம். ஆனால் சிறுநீரக நோயினால் பாதிக்கப்பட்டவர்களுக்கு இந்த இரசாயன ஊசி செலுத்தினால் நஞ்சு சார்ந்த பாதிப்பு ஏற்படும். எனவே டைனமிக் காண்டர் போனோ மீட்டர் பயன்படுத்தி அவர்களுக்கு எந்த பாதிப்பும் இல்லாமல் கண்ணில் சொட்டு மருந்து பயன்படுத்தி கண்ணின் துடிப்பு வீச்சை கண்டறிவதன் மூலம் விழித்திரையில் உள்ள இரத்த நாளங்களின் செயல்பாட்டின் விகிதத்தை துல்லியமாக அறிந்து கொள்ளலாம்.

இந்த ஆய்வில் பங்கேற்பவருக்கு எந்தவித பாதிப்பும், பக்க விளைவுகளும் ஏற்படாது. நீங்கள் பங்கேற்கும் போது வழக்கமான பரிசோதனை மேற்கொள்ளும் நேரத்திலேயே மேற்கூறிய ஆய்வுகள் செய்யப்படும். அதற்காக தனியாக நேரம் ஒதுக்கி செய்யப்படமாட்டாது.

இந்த ஆய்வின் போது எந்தவிதமான காயங்களும் ஏற்படாது. இந்த ஆய்வில் பங்கேற்பவருக்கு எந்தவிதமான பண உதவியும் அளிக்கப்படமாட்டாது. ஆய்வு முடிந்த பிறகு உங்களுடைய மருத்துவ விவரங்கள் அறிவியல் சார்ந்த இதழ்களில் வெளியிடப்படும். ஆனால் உங்களை பற்றிய குறிப்புகள் வெளியிடப்படமாட்டாது. கண் மருத்துவ துறையில் உங்கள் மருத்துவ விவரங்கள் பாதுகாப்பாக வைக்கப்படும். உங்களுடைய அனுமதியில்லாமல் உங்களின் மருத்துவ விவரங்கள் சில ஆய்வுகளுக்காக பயன்படுத்தலாம்.

குறிப்பு :

இது குறித்து மேலும் சில விவரங்களுக்கு [redacted] என்பவரை [redacted] தொலை பேசியிலும் அல்லது மின்னஞ்சல் [redacted] என்ற விலாசத்திலும் தொடர்பு கொள்ளலாம்.

CONSENT FORM IN TAMIL

ஒப்புதல் படிவம்

கண்ணின் விழி துடிப்பு வீச்சை (Ocular Pulse Amplitude) டைனமிக் காண்டர் போனோமெட்ரி (DCT)யைக் கொண்டு நீரிழிவு நோய் அல்லாத மற்றும் சிறுநீரக நோய்களால் பாதிப்புள்ளவர்கள் பயன்படுத்தி அறியப்படும் ஆய்வு.

ஆய்வு எண். :

பங்கேற்பாளரின் பெயர் :

மருத்துவமனை அட்டை எண் :

பிறந்த தேதி / வயது :

திரு. _____ அவர்களின் மகன் / மகள் ஆகிய நான் _____ மேற்கூறிய ஆய்வைப் பற்றிய தகவல்களை படித்து எனக்கு ஏற்படும் சந்தேகங்கள் கேட்டு தெரிந்து கொள்ளலாம் என்றும்

இந்த ஆய்வில் நான் முழு சம்மதத்துடன் பங்கேற்கவும் எந்த நிபந்தனையின்றி நான் இந்த ஆய்வில் விலகிக் கொள்ளலாம் என்றும் இதனால் எனக்கு வழக்கமாக மேற்கொள்ளும் மருத்துவ சிகிச்சையில் எந்த பாதிப்பும் இருக்காது என்றும் அறிந்திருக்கிறேன்.

இந்த ஆய்வு எனக்கு இலவசமாக செய்யப்படுகிறது என்பதையும் அறிந்திருக்கிறேன்.

இந்த ஆய்வின் ஆய்வாளர் மற்றும் மருத்துவ குழு உறுப்பினர்கள் என்னுடைய மருத்துவ குறிப்புகளை நான் விலகினாலும் அதை பயன்படுத்தி கொள்வதற்கு சம்மதம் அளிக்கிறேன்.

என்னுடைய மருத்துவ குறிப்புகளை வேறு எந்த நபருக்கும் தெரிவிக்கப்பட மாட்டாது என்றும் அறிந்திருக்கிறேன்.

என் முழு மனசம்மதத்துடன் இந்த ஆய்வில் பங்கேற்க சம்மதிக்கிறேன்.

பெயர் :

கையொப்பம் / ಹೆಬ್ಬೆರಳು ಗು :

தேதி :

சாட்சியின் பெயர் :

பங்கேற்பாளரின் உறவு முறை :

தேதி :

PATIENT INFORMATION SHEET IN HINDI

क्रिश्चियन मेडिकल कॉलेज, वेल्लोर

नेत्र विज्ञान विभाग

अंत मंच वृक्क रोग के साथ सामान्य डायलिसिस और गतिशील कंटूर Tonometry एक क्रॉस अनुभागीय अध्ययन का उपयोग व्यक्तियों पर गैर मधुमेह रोगियों में नेत्र स्पंद आयाम

रोगी सूचना पत्रक

आप एक अध्ययन में भाग लेने के लिए डायलिसिस और एक साधन गतिशील कंटूर टनमीटर (डीसीटी) कहा जाता है के साथ सामान्य व्यक्तियों पर गुर्दे की बीमारी के साथ रोगियों में नेत्र स्पंद आयाम (OPA) के माप में अंतर देखने के लिए अनुरोध किया जा रहा है. इस उपकरण के लिए intraocular दबाव (IOP) जो एक चकाचौंध मोतियाबिंद नामक रोग के निदान में महत्वपूर्ण है उपाय करने के लिए प्रयोग किया जाता है. IOP मापने के साथ साथ, डीसीटी भी OPA उपाय. हम इस अस्पताल के बारे में से 88 (44 और गुर्दे की बीमारी के साथ कोई गुर्दे की बीमारी के साथ 44) इस अध्ययन के लिए रोगियों को शामिल करने की उम्मीद है.

OPA और डीसीटी क्या कर रहे हैं?

OPA आंख के लिए रक्त की आपूर्ति के लिए विशेष रूप से choroidal रक्त वाहिकाओं जो रेटिना के पोषण में मदद करता है के एक अप्रत्यक्ष सूचक है. रेटिना आंख के प्रकाश के प्रति संवेदनशील हिस्सा है. रंजितपटल संबंधी छिड़काव गुर्दे की बीमारी के साथ रोगियों में कम हो जाती है. Indocyanine ग्रीन एंजियोग्राफी इन रोगियों में पहले choroidal छिड़काव पर देखने के लिए इस्तेमाल किया गया है. लेकिन यह एक आक्रामक प्रक्रिया है, जो शरीर में एक डाई इंजेक्शन और आंख की तस्वीरें लेने की आवश्यकता है. यह डाई गुर्दों को विषैला होता है और रोगियों को जो गुर्दे की बीमारी में निश्चित रूप से पसंद नहीं है. OPA के मापन डीसीटी का उपयोग कर एक गैर इनवेसिव प्रक्रिया है जो केवल एक सामयिक आंख में डाले जा चतनाशून्य करनेवाली औषधि की आवश्यकता है.

क्या परीक्षण किसी भी पक्ष प्रभाव है?

नहीं इस परीक्षण के लिए कोई महत्वपूर्ण साइड इफेक्ट होते हैं.

अगर तुम भाग लेने के लिए आप क्या करना होगा?

यदि आप इस अध्ययन में भाग लेने के लिए सहमत हैं, तो आप एक पूर्ण नेत्र OPA डीसीटी माप का उपयोग कर सहित परीक्षा के लिए आने वाले है. यह किसी भी नियमित नेत्र परीक्षण की तरह हो सकता है और कोई अतिरिक्त समय नहीं लगेगा.

आप इस अध्ययन से वापस लेने के बाद यह शुरू होता है?

इस अध्ययन में आपकी भागीदारी स्वैच्छिक है. अध्ययन में भाग लेने के लिए सहमति देने के लिए इस अस्पताल में अपने इलाज को प्रभावित नहीं करेगा.

अगर आप किसी भी अध्ययन से संबंधित चोट का विकास क्या होगा?

यह प्रक्रिया किसी भी आंख का चोटों की संभावना नहीं है.

आप परीक्षण के लिए भुगतान करना होगा?

कोई भुगतान के अध्ययन के लिए किया गया परीक्षण के लिए आवश्यक है.

अध्ययन के बाद खत्म हो गया है क्या होता है?

बाद अध्ययन अध्ययन के परिणामों पर वैज्ञानिक पत्रिकाओं में प्रकाशित किया जाएगा. प्रतिभागियों के किसी भी नाम या पहचान प्रकाशित नहीं किया जाएगा. अस्पताल के रिकॉर्ड नेत्र विज्ञान विभाग में रखा जाएगा. इच्छुक रोगियों अध्ययन के परिणामों के बारे में बताया जा सकता है.

आपकी व्यक्तिगत जानकारी को गोपनीय रखा जाएगा?

इस अध्ययन के परिणामों को एक मेडिकल जर्नल में प्रकाशित किया जाएगा, लेकिन आप नाम से किसी भी प्रकाशन या परिणामों की प्रस्तुति में नहीं पहचाना जाएगा. हालांकि, अध्ययन से जुड़े लोगों द्वारा अपने मेडिकल नोट्स समीक्षा की जा सकता है अपने अतिरिक्त अनुमति के बिना, आप इस अध्ययन में भाग लेने का फैसला करना चाहिए.

CONSENT FORM IN HINDI

एक चिकित्सीय परीक्षण में भाग लेने के के लिए सहमति

अध्ययन शीर्षक: अंत मंच वृक्क रोग के साथ सामान्य डायलिसिस और गतिशील कंटूर Tonometry एक क्रॉस अनुभागीय अध्ययन का उपयोग व्यक्तियों पर गैर मधुमेह रोगियों में नेत्र स्पंद आयाम

अध्ययन संख्या:

प्रतिभागी का नाम:

कोई अस्पताल:

जन्म / Age की तारीख (वर्षों में):

I_____,

बेटे की बेटी / _____

(कृपया टिक बक्से)

• घोषणा की कि मैंने पढ़ा है मुझे इस अध्ययन के बारे में जानकारी पत्रक प्रदान करने और किसी भी संदेह है कि मैं था स्पष्ट है. []

• मैं भी समझते हैं कि इस अध्ययन में मेरी भागीदारी पूरी तरह स्वैच्छिक है और मुझे मेरे सामान्य उपचार या अपने कानूनी अधिकारों को प्रभावित किए बिना करने के लिए किसी भी समय में भाग लेने के लिए जारी करने की अनुमति को वापस लेने के लिए स्वतंत्र है कि []

• मैं भी समझते हैं कि परीक्षण की लागत से मुक्त [] किया जाएगा

• मैं इस बात को समझता हूँ कि अध्ययन कर्मचारियों और संस्थागत नैतिकता समिति के सदस्यों को मेरी अनुमति की जरूरत नहीं है मेरे स्वास्थ्य रिकॉर्ड को देखने भी अगर मैं परीक्षण से हट जाएगा. मैं इस का उपयोग करने के लिए सहमत []

मैं समझता हूँ कि मेरी पहचान किसी भी तीसरे पक्ष के लिए जारी सूचना में या परिणाम प्रकाशित कर रहे हैं जब खुलासा नहीं किया जाएगा []

• मैं स्वेच्छा से इस अध्ययन में भाग लेने के] [करने के लिए सहमत

नाम:

हस्ताक्षर/अँगूठा निशान:

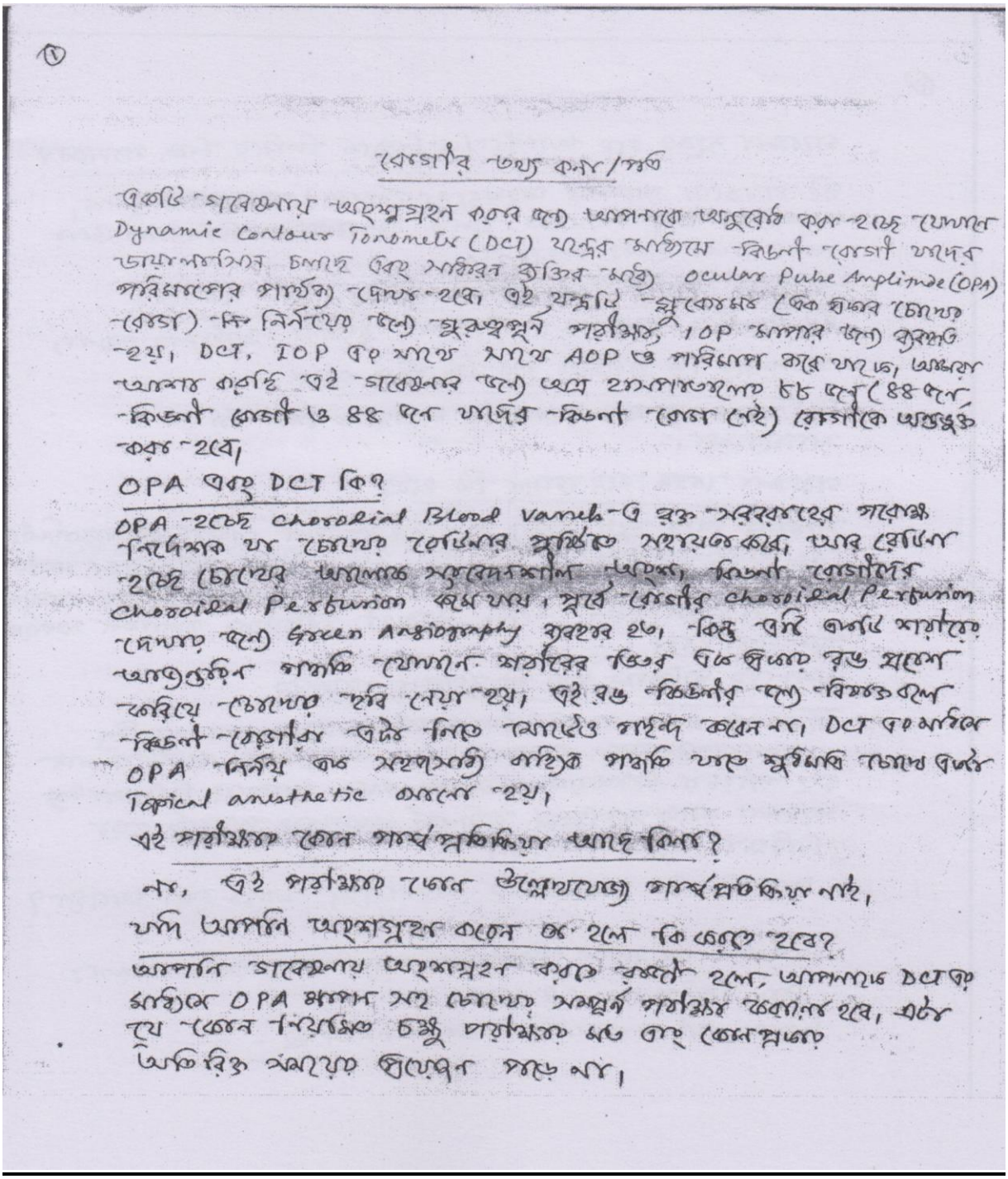
तिथि:

गवाह का नाम:

भागीदार के संबंध:

तारीख

PATIENT INFORMATION SHEET IN BENGALI



১

রোগীর তথ্য কপি/পত্র

একটি গবেষনায় অংশগ্রহন করার জন্য আপনাকে অনুরোধ করা হচ্ছে যেখানে Dynamic Contour Tonometer (DCT) যন্ত্রের মাধ্যমে কিছু রোগী যাদের ডায়াবেটিস চলছে তাদের সঙ্কির কৃতির মধ্যে Ocular Pulse Amplitude (OPA) পরিমাপের পার্থক্য দেখা হবে। এই যন্ত্রটি গ্লুকোমের ঠিক হারের চোখ (রোগ) কি নির্ণয়ে জন্য ঘুরঘুরন পরীক্ষা, IOP মাপার জন্য করাও হয়। DCT, IOP এর সাথে সাথে AOP ও পরিমাপ করে থাকে, আমরা আমার কয়েকটি এই গবেষনার জন্য ছোট হাসপাতালের ৮৮ জন (৪৪ জন কিছু রোগী ও ৪৪ জন যাদের কিছু রোগ নেই) রোগীকে অন্তর্ভুক্ত করা হবে।

OPA এবং DCT কি?

OPA হচ্ছে Choroidal Blood Vessels-এ রক্ত সরবরাহের সংকেত নির্দেশক যা চোখের রেটিনার সুস্থিতে সহায়তা করে, আর রোগ হচ্ছে চোখের আলোক সংবেদনশীল স্নায়ু, কিছু রোগীদের Choroidal Perfusion কম থাকে। সুস্থ রোগীর Choroidal Perfusion দেখার জন্য Green Angiography ব্যবহার হত। কিন্তু এটি করতে শরীরে অতিরিক্ত পরিমাণ ফ্লোরেন শরীরের ভিতর দিয়ে শিরায় রঙ প্রবেশ করিয়ে চোখের ছবি নেয়া হয়। এই রঙ কিছুটার জন্য বিষক্রিয়া হলে কিছু রোগীর তাই নিতে আগ্রহী করেন না। DCT এবং সাথে OPA নির্ণয় করা সহজসাধ্য নয়িক পদ্ধতি যাতে সুচিকিৎসা চোখে ওষুধ Topical anesthetic করানো হয়।

এই পরীক্ষা কোন পার্শ্বপ্রতিক্রিয়া আছে কিনা?

না, এই পরীক্ষা কোন উল্লেখযোগ্য পার্শ্বপ্রতিক্রিয়া নাই।

যদি আপনি অংশগ্রহন করেন বা না করলে কি করতে হবে?

আপনি গবেষনায় অংশগ্রহন করতে রাজী হলে, আপনাকে DCT এর মাধ্যমে OPA মাপা সহ চোখের সম্পূর্ণ পরীক্ষা করানো হবে, এটা ছাড়া কোন নিয়মিত চক্ষু পরীক্ষার মত এর কোন অতিরিক্ত ঝামেলা পোহাতে হবে না।

[redacted]

ঃ নমুনা হিসেবে কিছু শব্দ লেখো যেগুলো দিয়ে বাক্য গঠন করা যায়।

ঃ ছাত্রটি ক্লাস শেষে শিক্ষকের সঙ্গে কী কী আলোচনা করেছিল?

ঃ ছাত্রটি কী কী বিষয় নিয়ে আলোচনা করেছিল?

ঃ ছাত্রটি কী কী বিষয় নিয়ে আলোচনা করেছিল?

ঃ ছাত্রটি কী কী বিষয় নিয়ে আলোচনা করেছিল?

ঃ ছাত্রটি কী কী বিষয় নিয়ে আলোচনা করেছিল?

ঃ ছাত্রটি কী কী বিষয় নিয়ে আলোচনা করেছিল?

ঃ ছাত্রটি কী কী বিষয় নিয়ে আলোচনা করেছিল?

ঃ ছাত্রটি কী কী বিষয় নিয়ে আলোচনা করেছিল?

CONSENT FORM IN BENGALI

③

Clinical Trial এ অংশগ্রহণ করার সম্মতি পত্র

আমি - - - - - বয়স পুত্র/কন্যা - - - -

(প্রযোজ্য দিন)

। ঘোষণা করছি যে, আমি কি গবেষণার সম্পর্কিত তথ্য পড়েছি/শুনেছি এবং আমার সব বিষয়ের আমার তথ্য পরিষ্কার করে বুঝে নিয়েছি, [ ]

। আমি এটাও বুঝেছি যে, এই গবেষণায় আমার অংশগ্রহণ সম্পূর্ণ স্বেচ্ছামূলক এবং আমি যে কোন সময় আমাকে ফিরিয়ে নিতে পারি, এতে আমার চিকিৎসা এবং আইনত অধিকারের এতটুকু ক্ষুণ্ণ হবেনা।

। আমি আরও বুঝেছি যে, এই পরীক্ষা হবে বিনামূল্যে।

। আমি বুঝেছি যে গবেষণার কর্তা এবং প্রতিষ্ঠানের Ethical Committee এর সদস্য বৃন্দ আমার সমস্ত তথ্য আমার অনুমতি ছাড়াই দেখতে পারবেন, এমনকি আমি নিজেকে সরিয়ে নিলেও। আমি এতে সম্মত আছি।

। আমি বুঝেছি যে আমার পরিচয় সম্পর্কিত কোন তথ্য কোন তৃতীয় কাউকে দেওয়া হবেনা অথবা গবেষণার প্রকাশের সময়ও এটা মানা হবে,

। আমি স্বেচ্ছায় এই গবেষণায় অংশগ্রহণ করছি,

নাম:—
স্বাক্ষর:—
তারিখ—
সাক্ষীর নাম -
স্বাক্ষর —
তারিখ—

PATIENT INFORMATION SHEET IN TELUGU

తెలుపబడ్డ

క్రిస్టియన్ మెడికల్ కాలేజ్, వెల్లూరు

నేత్ర వైద్య శాఖ

డయాలసిస్ మరియు డైనమిక్ సమోన్నత కన్ను గుడ్డులోని ఒత్తిడి నిర్ణయించుట-A క్రాస్ సెక్షనల్ అధ్యయనం ఉపయోగించి సాధారణ వ్యక్తులపై చివరి దశలోని మూత్రపిండ వ్యాధి కాని మధుమేహ రోగులు సంబంధిత పల్స్ ఆమ్ప్లిట్యూడ్

రోగి సమాచార షీట్

మీరు డయాలిసిస్ మరియు డైనమిక్ సమోన్నత కన్ను గుడ్డు లోపలి ఒత్తిడిని కొలిచే సాధనం (DCT) అని ఒక పరికరం సాధారణ వ్యక్తులపై మూత్రపిండ వ్యాధి ఉన్న రోగులలో సంబంధిత పల్స్ ఆమ్ప్లిట్యూడ్ (OPA) యొక్క కొలత తేడా చూడటానికి ఒక అధ్యయనంలో పాల్గొనేందుకు అభ్యర్థించిన చేస్తున్నారు. ఈ పరికరం గ్లాకోమా అనే బ్లైండింగ్ వ్యాధి నిర్ధారణలో ముఖ్యమైన ఇది కంటిలోని ఒత్తిడి (IOP) కొలిచేందుకు ఉపయోగిస్తారు. IOP కొలిచే పాటు, DCT కూడా OPA కొలుస్తుంది. మేము ఈ అధ్యయనం కోసం ఈ ఆసుపత్రి నుండి 88 రోగులకు (ఏ మూత్రపిండ వ్యాధి మూత్రపిండ వ్యాధి 44 మరియు 44) ఉన్నాయి ఆశిస్తున్నాము.

OPA మరియు DCT ఏమిటి?

OPA కన్ను రక్త సరఫరా రెటీనా పోషికాహార సహాయం చేస్తున్న ముఖ్యంగా choroidal రక్తనాళాలు, ఒక పరోక్ష సూచిక. రెటీనా కంటి కాంతి సున్నితమైన భాగం. Choroidal పంపిణీ మూత్రపిండ వ్యాధి ఉన్న రోగులలో క్షీణిస్తుంది. గ్రీన్ ఆంజియోగ్రఫి Indocyanine ముందు ఈ రోగులలో choroidal పంపిణీ కు ఉపయోగిస్తారు. కానీ ఈ శరీరం ఒక డై సూది మరియు కంటి చిత్రాలు తీయడం అవసరం ఒక గాటు ప్రక్రియ ఉంది. ఈ రంగు మూత్రపిండాలు హానికరము మరియు ఖచ్చితంగా మూత్రపిండ వ్యాధి కలిగిన రోగులకు ప్రాధాన్యత లేదు. DCT ఉపయోగించి OPA యొక్క కొలత మాత్రమే కన్ను నాటబడ్డాయి ఒక సమయోచిత మత్తు అవసరమైన కాని హానికర ప్రక్రియ.

పరీక్ష ఏ ప్రభావాలను కలిగి ఉందా?

నం ఈ పరీక్ష కోసం ఎటువంటి ప్రభావాలు కూడా ఉన్నాయి.

మీరు పాల్గొనడానికి ఉంటే మీరు ఏమి ఉంటుంది?

మీరు ఈ అధ్యయనంలో పాల్గొనేందుకు మీరు అంగీకరిస్తున్నారు, మీరు DCT ఉపయోగించి OPA కొలత సహా ఒక పూర్తి కంటి పరీక్ష కోసం చేయగలగాలి. ఈ ఏ రొటీన్ కంటి పరీక్ష వంటి ఉంటుంది మరియు ఏ అదనపు సమయం తీసుకోదు.

ఇది మొదలవుతుంది తర్వాత మీరు ఈ అధ్యయనం నుండి వెనక్కి తీసుకోవచ్చు?

ఈ అధ్యయనంలో మీ భాగస్వామ్యం నిర్వహించబడుతుంది. అధ్యయనంలో భాగస్వామ్యం కోసం అనుమతి ఇవ్వడం లేదు ఈ ఆసుపత్రిలో చికిత్స మీ ప్రభావితం చేయదు.

మీరు ఏ అధ్యయనం సంబంధిత గాయం అభివృద్ధి చేస్తే ఏమవుతుంది?

ఈ ప్రక్రియ ఏదైనా కంటి గాయాలు అవకాశం లేదు.

మీరు పరీక్ష కోసం చెల్లించవలసి ఉంటుంది?

సంఖ్య చెల్లింపు అధ్యయనం చేసిన పరీక్షలు అవసరం.

అధ్యయనం పూర్తయ్యాక ఏమి జరుగుతుంది?

అధ్యయనం అధ్యయన ఫలితాలు ముగిసిన తర్వాత శాస్త్రీయ పత్రికలు ప్రచురించబడుతుంది. పాల్గొనేవారు ఏ పేర్లు లేదా గుర్తింపు ప్రచురితమైన కాదు. ఆసుపత్రి రికార్డులు నేత్ర వైద్య Dept లో ఉంచబడుతుంది. ఆసక్తి అధ్యయన ఫలితాలు ముట్టిడిపై చేయవచ్చు.

మీ వ్యక్తిగత వివరాలు గోప్యంగా ఉంచబడుతుంది?

ఈ అధ్యయనం యొక్క ఫలితాలు మెడికల్ జర్నల్ లో ప్రచురించిన కానీ మీరు ఫలితాలు ఏ ప్రచురణ లేదా ప్రదర్శనలో పేరు ద్వారా గుర్తించలేము. అయితే, మీ వైద్య గమనికలు మీ అదనపు అనుమతి లేకుండా, అధ్యయనం సంబంధం ప్రజలు పునఃసమీక్షిస్తాడు, మీరు ఈ అధ్యయనంలో పాల్గొనేందుకు నిర్ణయించుకుంటారు ఉండాలి.

లేదా ఇమెయిల్:

CONSENT FORM IN TELUGU

వైద్య పరీక్షలను పాల్గొనడానికి సమ్మతించారు

స్టడీ శీర్షిక: డయాలిసిస్ మరియు డైనమిక్ సమోన్నత కన్నుగుడ్డులోని ఒత్తిడి నిర్ణయించుట-A క్రాస్ సెక్షనల్ అధ్యయనం ఉపయోగించి సాధారణ వ్యక్తులపై చివరి దశలోని మూత్రపిండ వ్యాధి కాని మధుమేహ రోగులు సంబంధిత పల్స్ ఆమ్ప్లిట్యూడ్

స్టడీ సంఖ్య:

పార్టిసిపెంట్ యొక్క పేరు:

హాస్పిటల్ సంఖ్య:

పుట్టిన / వయసు తేదీ (సంవత్సరాలలో):

I_____,

సన్ / _____ కుమార్తె

(దయచేసి టిక్ పెట్టెలు)

• నేను సమాచారం షీట్ ఈ అధ్యయనం గురించి నాకు అందించడానికి చదివి నేను కలిగి ఉన్న అనుమానాలను వివరించారు చేసిన ప్రకటిస్తాయి. [ ]

• నేను కూడా ఈ అధ్యయనంలో నా పాల్గొనడం పూర్తిగా స్వచ్ఛంద మరియు నా సాధారణ చికిత్స లేదా నా చట్టపరమైన కు ప్రభావితం లేకుండా ఏ సమయంలోనైనా పాల్గొనేందుకు కొనసాగించడానికి అనుమతి ఉపసంహరించుకోవాలని ఉచిత అని అర్థం [ ]

• నేను కూడా పరీక్ష ఉచితంగా కూడా అర్థం చేసుకున్నాను [ ]

• నేను విచారణ నుండి వెనక్కి కూడా అధ్యయనం సిబ్బంది మరియు ఎథిక్స్ కమిటీ సభ్యులు సంస్థాగత నా ఆరోగ్య

రికార్డులను కు నా అనుమతి అవసరం లేదు అని అర్థం. నేను ఈ యాక్సెస్ అంగీకరిస్తున్నారు [ ]

• నా గుర్తింపును మూడవ పార్టీలకు విడుదలైన సమాచారం లేక ఫలితాలు ప్రచురించిన బహిర్గతం చెయ్యబడదు అర్థం [ ]

• నేను స్వచ్ఛందంగా ఈ అధ్యయనంలో పాల్గొనేందుకు మీరు అంగీకరిస్తున్నారు [ ]

పేరు:

సంతకం / బ్రొటనవేలు ముద్ర:

తేదీ:

సాక్షి పేరు:

అభ్యర్థి సంబంధం:

తేదీ:

ANNEXURE III

IRB REVIEW BOARD (IRB) APPROVAL

INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE
VELLORE 632 002, INDIA

Dr.B.J.Prashantham, M.A.,M.A.,Dr.Min(Clinical)
Director, Christian Counseling Centre
Editor, Indian Journal of Psychological Counseling
Chairperson, Ethics Committee, IRB

Dr. Alfred Job Daniel, D (Ortho), MS Ortho, DNB (Ortho)
Chairperson, Research Committee &
Principal

Dr. Nihal Thomas
MD, MNAMS, DNB(Endo), FRACP(Endo), FRCP(Edin)
Secretary, Ethics Committee, IRB
Additional Vice Principal (Research)

February 6, 2013

Dr. Shimna. C. P
PG Registrar
Department of Ophthalmology
Christian Medical College
Vellore 632 002

Sub: **FLUID Research grant project NEW PROPOSAL:**
Ocular Pulse Amplitude in non diabetic patients with end stage renal disease on dialysis and normal individuals using Dynamic Contour Tonometry: A Cross Sectional study.
Dr. Shimna. C. P, PG Registrar, Ophthalmology, Dr Lekha Mary Abraham, Dr. Arathi Simha R, Ophthalmology, Dr Vinoi George David, Santosh Varghese, Nephrology.

Ref: IRB Min. No. 8167 dated 09.01.2013

Dear Dr. Shimna. C. P,

The Institutional Review Board (Blue, Research and Ethics Committee) of the Christian Medical College, Vellore, reviewed and discussed your project entitled "Ocular Pulse Amplitude in non diabetic patients with end stage renal disease on dialysis and normal individuals using Dynamic Contour Tonometry: A Cross Sectional study." on January 09, 2013.

The Committees reviewed the following documents:

1. Format for application to IRB submission
2. Patient Information Sheet and Informed Consent Form (English, Tamil, Hindi, Telugu and Bengali)
3. Clinical Proforma
4. Cvs of Drs. Shimna. C, Lekha Mary, Arathi Simha R, Vinoi George David, Santosh Varghese
5. A CD containing documents 1 - 4

TEL : 0416 - 2284294, 2284202 FAX : 0416 - 2262788, 2284481 E-mail : research@cmcvellore.ac.in

INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE
VELLORE 632 002, INDIA

Dr.B.J.Prashantham, M.A.,M.A.,Dr.Min(Clinical)
Director, Christian Counseling Centre
Editor, Indian Journal of Psychological Counseling
Chairperson, Ethics Committee, IRB

Dr. Alfred Job Daniel, D (Ortho), MS Ortho, DNB (Ortho)
Chairperson, Research Committee &
Principal

Dr. Nihal Thomas
MD, MNAMS, DNB(Endo), FRACP(Endo), FRCP(Edin)
Secretary, Ethics Committee, IRB
Additional Vice Principal (Research)

The following Institutional Review Board (Research & Ethics Committee) members were present at the meeting held on Janauray 9, 2013 in the CREST/SACN Conference Room, Christian Medical College, Bagayam, Vellore 632002.

Name	Qualification	Designation	Other Affiliations
Dr. Susanne Abraham	MBBS, MD	Professor, Dermatology, Venerlogy & Leprosy, CMC.	Internal, Clinician
Dr. Benjamin Perakath	MBBS, MS, FRCS	Professor, Surgery (Colorectal), CMC.	Internal, Clinician
Dr. Ranjith K Moorthy	MBBS MCh	Professor, Neurological Sciences, CMC	Internal, Clinician
Dr. P. Prasanna Samuel	B.Sc, M.Sc, PhD	Professor Dept. of Biostatistics, CMC	Internal, Statistician
Dr. Balamugesh	MBBS, MD(Int Med), DM, FCCP (USA)	Professor, Dept. of Pulmonary Medicine, CMC.	Internal, Clinician
Dr. Simon Rajaratnam	MBBS, MD, DNB (Endo), MNAMS (Endo), PhD (Endo), FRACP	Professor, Endocrinology, CMC	Internal, Clinician
Dr. Anup Ramachandran	PhD	The Wellcome Trust Research Laboratory Gastrointestinal Sciences	Internal
Dr. Chandrasingh	MS, MCH, DMB	Urology, CMC	Internal, Clinician
Dr. Paul Ravindran	PhD, Dip RP, FCCPM	Professor, Radiotherapy, CMC	Internal

TEL : 0416 - 2284294, 2284202 FAX : 0416 - 2262788, 2284481 E-mail : research@cmcvellore.ac.in

INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE
VELLORE 632 002, INDIA

Dr.B.J.Prashantham, M.A.,M.A.,Dr.Min(Clinical)
Director, Christian Counseling Centre
Editor, Indian Journal of Psychological Counseling
Chairperson, Ethics Committee, IRB

Dr. Alfred Job Daniel, D (Ortho), MS Ortho, DNB (Ortho)
Chairperson, Research Committee &
Principal

Dr. Nihal Thomas
MD, MNAMS, DNB(Endo), FRACP(Endo), FRCP(Edin)
Secretary, Ethics Committee, IRB
Additional Vice Principal (Research)

Dr. Anand Zachariah	MBBS, MD, DNB	Professor, Dept. of Medicine, CMC	Internal, Clinician
Mrs. Pattabiraman	BSc, DSSA	Social Worker, Vellore	External, Lay Person
Mr. Sampath	BSc, BL	Advocate	External, Legal Expert
Mr. Harikrishnan	BL	Lawyer, Vellore	External, Legal Expert
Mr. Samuel Abraham	MA, PGDBA, PGDPM, M.Phil, BL	Legal Advisor, CMC.	Internal, Legal Expert
Mr. Joseph Devaraj	BSc, BD	Chaplain, CMC	Internal, Social Scientist
Dr. B. J. Prashantham (Chairperson), IRB Blue Internal	MA (Counseling), MA (Theology), Dr Min(Clinical	Chairperson(IRB)& Director, Christian Counselling Centre	External, Scientist
Dr. Jayaprakash Muliyil	BSC, MBBS, MD, MPH, DrPH(Epid), DMHC	Retired Professor, Vellore	External, Scientist
Dr. Nihal Thomas	MD MNAMS DNB(Endo) FRACP(Endo) FRCP(Edin)	Secretary IRB (EC)& Dy. Chairperson (IRB), Professor of Endocrinology & Addl. Vice Principal (Research), CMC.	Internal, Clinician

TEL : 0416 - 2284294, 2284202 FAX : 0416 - 2262788, 2284481 E-mail : research@cmcvellore.ac.in

INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE
VELLORE 632 002, INDIA

We approve the project to be conducted as presented.

The Institutional Ethics Committee expects to be informed about the progress of the project, any serious adverse events occurring in the course of the project, any changes in the protocol and the patient information/informed consent. And on completion of the study you are expected to submit a copy of the final report.

A sum of Rs. 38,980/- (Rupees Thirty Eight Thousand Nine Hundred and Eighty only) will be granted for One Years.

Yours sincerely

Dr. Nihal Thomas
Secretary (Ethics Committee)
Institutional Review Board

Dr Nihal Thomas
MBBS MD MNAMS DNB (Endo) FRACP(Endo) FRCP(Edin)
Secretary (Ethics Committee)
Institutional Review Board

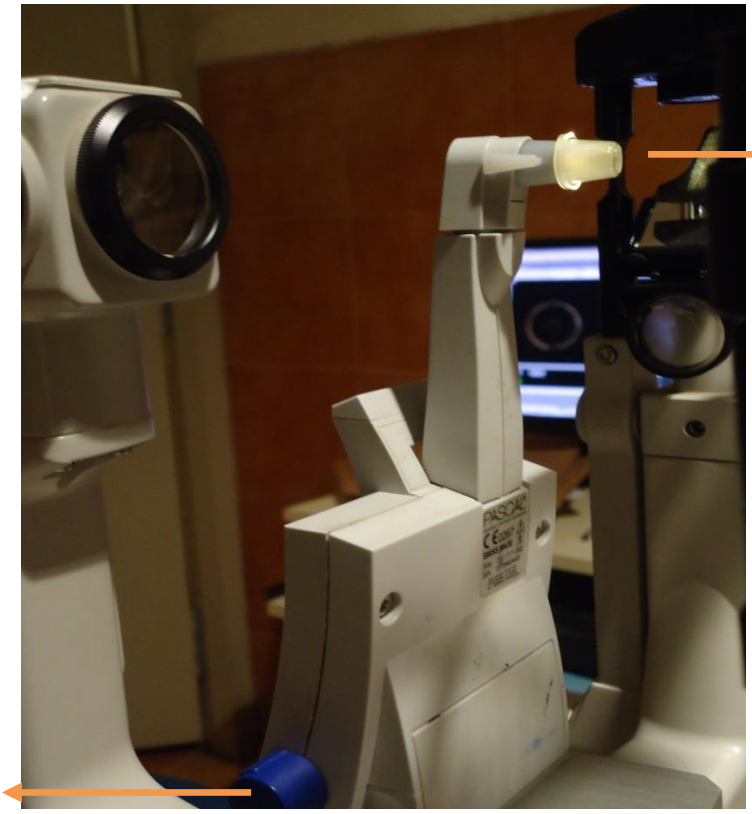
CC: Dr Lekha Mary Abraham, Department of Ophthalmology

TEL : 0416 - 2284294, 2284202 FAX : 0416 - 2262788, 2284481 E-mail : research@cmcvellore.ac.in

ANNEXURE IV

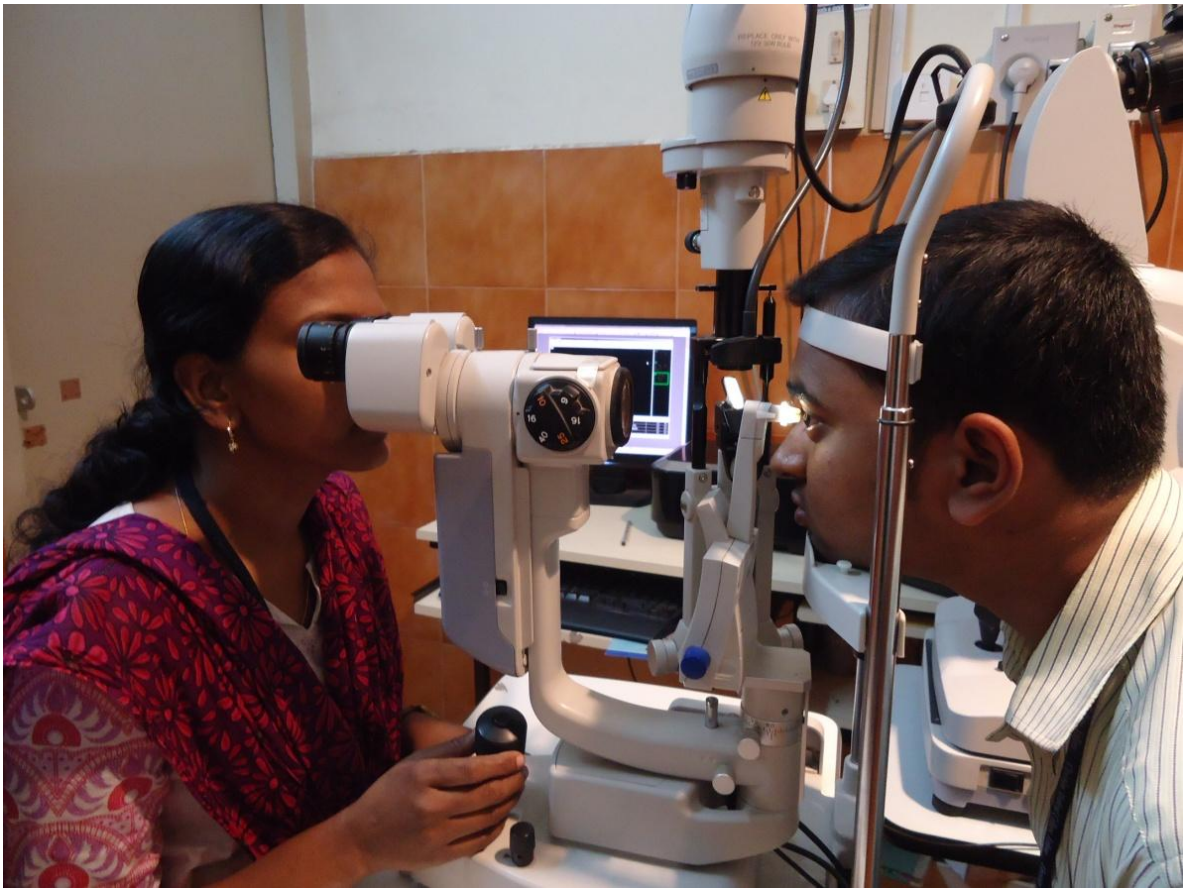
PICTURE 1

PICTURE 2 **DCT**



PICTURE 3

PICTURE 4



PICTURE 5

PICTURE 6

PICTURE 7

APPENDIX V

EXPOSED GROUP																			
					RIGHT EYE						LEFT EYE								
No	Hosp. No	Name of the patient	Age	Sex	OPA 1	OPA 2	OPA AVG	IOP 1	IOP 2	IOP AVG	OPA 1	OPA 2	OPA AVG	IOP 1	IOP 2	IOP AVG	BP	AC	S. Cr
1a	389126S	MANISH GIRI	35	M	3.6	3.4	3.5	18.5	19.5	19	3.4	3.4	3.4	19.5	18.9	19.2	140/80	79	12.42
2a	389124s	KAMESH. A	30	M	1.7	1.7	1.7	16.2	17.2	16.7	1.7	1.7	1.7	16.2	17.2	16.7	140/88	78	13.36
3a	389125s	ALOKKUMAR PANDEY	30	M	2.4	2.8	2.6	16.4	16.2	16.3	2.8	2.7	2.75	15.6	15.7	15.6	140/90	89	16.71
4a	169197s	ANNAL DAISY	44	F	1.7	1.7	1.7	17.2	18.4	17.8	2.1	2.2	2.15	17.2	18.4	17.8	130/84	86	8.96
5a	390114s	SHANTHI. P	40	F	2.9	2.9	2.9	18	18	18	3.9	3.9	3.9	18	18	18	120/84	80	7.31
6a	390082s	A. PUSHPARAJ	67	M	2.6	2.7	2.65	12.3	12.6	12.5	2.9	3.4	3.15	13.6	14	13.8	150/90	120	8.48
7a	390170s	JANAKIRAMAN	26	M	1.4	1.1	1.25	16.4	15.1	15.75	1.7	1.5	1.6	18.7	18.5	18.6	120/84	88	12.14
8a	390946s	ABHISHEK KUMAR YADAV	18	M	2.1	2.1	2.1	12.8	12.8	12.8	3.2	2.1	2.65	16.3	15.5	15.9	140/90	97	8.7
9a	390951s	MONTOSH ROY	34	M	2.6	2.1	2.35	13	13.2	13.1	1.9	1.9	1.9	13.7	13	13.5	140/94	87	15.35
10a	390986s	NAND LAL SAHU	28	M	1.5	1.5	1.5	12.7	12.7	12.7	1.8	2	1.9	14.9	14.6	14.7	130/80	84	10.62
11a	390948s	PAUL JAYASINGH	49	M	2.5	2.9	2.7	12.5	12.9	12.7	2.9	3	2.95	12.5	12.2	12.5	130/80	91	4.28
12a	391840s	DIPRIYA DHARA	37	F	1.7	1.7	1.7	17.8	17.8	17.8	1.7	1.7	1.7	16.1	16.1	16.1	130/90	94	8.15
13a	391832s	AJAY MONDAL	24	M	1	0.8	0.9	17	14.8	15.9	1.7	1.4	1.55	16.2	14.4	15.3	140/80	80	8.7
14a	391837s	TAPATI DEBNATH	40	F	1.6	1.3	1.75	16.1	16.2	16	1.2	1.3	1.25	16.1	16.6	16.3	140/84	86	8.67
15a	391835s	SATAKSHI MITRA	18	F	2.2	2.8	2.5	16.7	16.2	16.5	2	2	2	16	15.7	15.8	130/80	75	9.62
16a	391843s	ABHIJITH SAHA	22	M	1	1	1	15	15	15	1	1	1	17.3	17.3	17.3	130/80	79	12.92
17a	382758S	VENKATESAN. J	37	M	2.4	2.6	2.5	18.1	16.3	17.2	2.7	2.9	2.8	14.3	17.2	15.7	130/84	75	16.76
18a	391903s	SACHINA THATAL	18	F	1.2	1.2	1.2	17.7	17.7	17.7	0.9	0.9	0.9	15.8	15.8	15.8	120/80	88	8.6
19a	393032s	YESHI WANGMU	50	F	1.8	1	1.4	14.6	12.6	13.6	1.1	1.1	1.1	12.2	14.7	13.5	110/70	99	13.6
20a	408461s	RINCHEN LHAMO	32	M	2	1.7	1.85	16.2	14.2	15.2	1.9	2.4	2.15	14.5	14.2	14.4	110/70	93	16.89
21a	393080s	VELMURUGAN. H	30	M	2.2	2.4	2.1	18.2	18.9	18.5	3.4	3.2	3.3	17.3	17.8	17.6	140/80	86	19.7
22a	393059s	NEERAJ KUMAR SINGH	21	M	2.8	2.6	2.7	16.1	15.9	16	2.5	2.3	2.4	19.8	20.9	20.4	130/80	89	10.24
23a	393057s	MOORTHY. K	64	M	2.4	2.5	2.45	22.5	22.4	22.5	2.6	2.6	2.6	20.9	20.7	20.8	130/90	103	12.38
24a	393101s	PRATIK BABU	23	M	1.2	1.4	1.3	22.6	18.4	20.5	1.4	2	1.7	17.9	18.9	18.4	120/80	96	7.05
25a	393062s	CHIGING TAMA	29	M	1.4	1.4	1.2	14.1	14.1	14.1	1.3	1.7	1.5	11.8	12.3	12	140/70	90	7.04
26a	393068s	MANOHARAN	48	M	1.9	2.1	2	18.1	18.2	18	2.2	2.2	2.2	20.2	20.2	20.2	150/90	93	5.8
27a	393102s	RAMAKANTH PANDEY	47	M	1.4	1.5	1.45	15.2	13.7	14.5	1.1	1.4	1.25	10.7	11.8	11.3	120/80	84	15.03
28a	393959s	JEET NARAYAN	40	M	2.2	2.2	2.2	17.8	17.8	17.8	2.9	2.9	2.9	16.2	16.2	16.2	140/90	94	12.92
29a	395272s	MINA RANI DAS	46	F	3.4	3.2	3.3	15.4	16.3	15.8	3.2	3.1	3.15	14.1	14.1	14.1	130/80	115	10.73
30a	395264s	RITA RAJ	25	F	1	1	1	14.3	14.3	14.3	0.8	1	0.9	17.3	17.6	17.5	130/90	87	2.47
31a	404753s	NABAKANTHA BARAIYA	22	M	2	2	2	14.1	14.2	14	2	2	2	14.5	15.1	14.8	150/90	91	23.69
32a	405455s	THILAGAVATHY	30	F	1.6	1.6	1.6	19.2	19.2	19.2	1.5	1.2	1.35	18.3	16	17.2	130/90	88	7.27
33a	408417s	TANA MEENA	34	F	0.7	0.7	0.7	17.2	17.2	17.2	0.6	0.6	0.6	15	15	15	100/70	73	13.06
34a	411041s	VIJAYAKUMAR. P	28	M	1.8	1.8	1.8	16.4	16.4	16.4	2.6	2.5	2.45	14.8	14.7	14.8	140/94	85	7.5
35a	410964s	SATISH PRASAD	60	M	2.3	2.3	2.3	16.2	17	16.6	2.8	2.8	2.8	16.2	16.2	16.2	140/80	91	6.16
36a	412094s	DHIRENDRA KUMAR	24	M	1.9	1.9	1.9	15	15	15	2.5	2.5	2.5	13.1	13.1	13.1	130/80	86	4.6
37a	412747s	ASHISH CHOWDHARY	39	M	1.4	1.4	1.9	20.2	18.8	19.5	1.4	1.5	1.45	19.2	20.9	20.1	140/90	95	10.35
38a	412749s	ROBIN RAI	37	M	2.6	2.7	2.65	18.2	17.7	17.9	2.7	2.3	2.5	16.6	16.8	16.7	140/90	85	11.25
39a	415796s	BIPAT CHAUDHARY	58	M	2.1	1.7	1.9	20.9	19.7	20.3	3.5	3.5	3.5	20.4	20.6	20.5	140/90	102	4.32
40a	416204s	AROKIYADASS	38	M	1.3	1.4	1.35	16	13.2	14.6	1.6	1.2	1.4	17.1	16.8	17	120/90	90	6.86
41a	416176s	THENMOZHI	34	F	0.9	1.2	1.05	15.1	14.8	14.9	1.4	1.5	1.45	15.5	15.7	15.6	124/80	81	11.89
42a	416225s	LAKHI TACHANA	27	M	2.4	2.2	2.1	17.7	17.9	17.8	1.1	1.3	1.2	17.5	17.6	17.6	120/80	89	11.12
43a	416171s	MANAS BAYEN	23	M	2.7	2.7	2.7	18.3	16	17.2	2.5	2.1	2.3	18.7	16.7	17.7	110/60	88	1.02
44a	416228s	UDITAVARE	47	F	2.2	2.2	2.2	22.1	22.2	22.2	2.4	2.8	2.6	21.5	19.4	20.5	150/90	80	10.95

NON-EXPOSED																		
					RIGHT EYE						LEFT EYE							
No	Hosp. No	Name of the patient	Age	Sex	OPA 1	OPA 2	OPA AVG	IOP 1	IOP 2	IOP AVG	OPA 1	OPA 2	OPA AVG	IOP 1	IOP 2	IOP AVG	BP	AC
1b	403302s	DEBASHISH PAUL	35	M	3.8	3.6	3.7	13.2	14.8	14	2	2	2	14.7	14.7	14.7	100/80	106
2b	410367s	MANILAL SAHOO	31	M	2.6	2.6	2.6	17.8	17.2	17.5	2.5	2.7	2.6	18.3	18.6	18.5	120/70	82
3b	333863S	GLORY. I	35	F	2.8	2.6	2.7	16.8	16.4	16.6	2.8	2.8	2.8	16.2	17.1	16.7	110/80	88
4b	412619S	KASTHURI	44	F	2.9	2.9	2.9	19.2	18.4	18.8	3.5	3.1	3.3	19.4	18.2	18.8	110/70	113
5b	101056S	ARUL THOMAS	41	M	2.4	2.9	2.65	22.2	24.2	23.2	3	2.4	2.7	24.2	25.3	24.8	110/70	90
6b	928433e	HABEEB KHAN	64	M	1.9	2.6	2.25	12.2	13.2	12.7	3.4	3.6	3.5	13.9	13.4	13.7	120/70	113
7b	409211s	OLIVIA MITRA	21	F	2.8	1.4	2.1	19.7	18.9	19.3	2.5	2.5	2.5	17.3	18.7	18	120/74	79
8b	412705s	BHARATHI	18	F	2.1	2.6	2.35	17	16.6	16.8	2.5	2.1	2.7	14.1	14.2	14.2	90/70	87
9b	771390e	NAOMI SHEEBA	34	F	2.1	0.9	1.5	10.5	8.1	9.3	2.2	2.5	2.3	8.1	8.9	8.5	90/60	98
10b	413216s	MAGI.G	25	M	2.7	2.7	2.7	17.6	17.3	17.5	2	2.7	2.35	17.3	17.8	17.6	120/80	105
11b	414818s	SUMATHI. K	52	F	1.7	1.7	1.7	15.9	16.3	16.1	2.5	2.5	2.5	18.6	17.9	18.3	120/80	113
12b	409616s	B. GEETHA	38	F	0.7	1.1	0.9	17.6	15	16.3	2.5	2.7	2.6	19.5	18.7	19.1	110/80	88
13b	399850s	RATHINESHWARI	24	F	0.8	2.7	1.75	20	17.6	18.8	2	1.8	1.9	20	19.5	19.8	110/70	93
14b	410373s	DEIVANAI	40	F	2.5	2.5	2.5	10.2	10.2	10.2	1.6	1.6	1.6	10.4	10.4	10.4	120/70	95
15b	338931s	MUDASHIR AHMED	19	M	2.8	2.4	2.6	20.4	20.4	20.4	1.9	1.7	1.8	21.2	20.3	20.8	120/80	92
16b	856495e	SARAN KUMAR	23	M	3	2	2.5	21.4	22.8	22.1	2.5	2.5	2.5	21	19	20	110/70	92
17b	412539s	SHANTHI. K	42	F	2	2.4	2.2	20.4	20.4	20.4	2.4	2.1	2.25	19.4	19.3	19.4	110/80	95
18b	412231s	RINI DHAIRYAMANI	19	F	1.2	1.6	1.4	18.3	19.5	18.9	1.7	1.3	1.5	17.4	16.1	16.8	110/60	84
19b	414951s	SHAKILABEE	45	F	1.9	1.8	1.85	18.3	19.4	18.9	2.4	2.2	2.2	15.5	16.4	16	100/70	99
20b	414785s	MANASHI RANA	28	F	1.7	2.5	2.1	20.2	21.8	21	2.7	3.3	3	20.3	19.5	19.9	110/80	119
21b	413889s	SUSILA	28	F	2.4	3	2.7	18.6	17.9	18.3	2.5	2.5	2.5	14.3	14.7	14.5	110/80	102
22b	393862s	MALINI	21	F	2.1	2.8	2.45	17.2	17	17.1	2	3	2.5	16.3	16.5	16.4	120/80	98
23b	408909s	VIJAYALAKSHMI. R	59	F	2.2	2.4	2.3	18.3	15.5	16.9	2.7	2.2	2.45	14.8	17.3	16.1	100/70	110
24b	414831s	GOMATHY. T	19	F	1.2	1.2	1.2	15.8	14	14.9	2.2	1.3	1.75	15.7	15.3	15.5	120/70	88
25b	295964s	NANNIMALAR	29	F	1.4	2.6	2	19.9	18.8	19.4	2.1	2.1	2.1	11.7	11.7	11.7	120/80	91
26b	395218s	ARUNTHAMARAI	48	F	1	1.9	1.45	19.5	17.6	18.6	1.8	1.8	1.8	11.8	11.1	11.5	120/80	102
27b	410307s	DURGA. R	48	F	1.5	2.9	2.2	14.1	13.6	13.9	2.8	3.4	3.1	17.6	17	17.3	110/80	105
28b	410968s	A. ANTHONY RAJ	39	M	3.3	3.3	3.3	15.3	16.9	16.1	2.4	3.1	2.75	16	15.7	15.9	110/70	103
29b	412027s	MALIKA NARASIMHAM	47	F	3	3	3	18.5	19	18.8	3.7	3.2	3.45	16.6	16.6	16.6	120/80	116
30b	410313s	TAMIZHA. M	25	F	2	2	2	18	19.2	18.6	1.6	2	1.8	22.7	22.6	22.7	90/70	95
31b	410242s	REETA KUMARI	21	F	1.2	2	1.6	16.9	15.4	16.2	3	2	1.5	16.3	18.2	17.3	80/60	88
32b	415156S	RINKY SAH	33	F	1.6	1.8	1.7	15.3	16.2	15.8	1.2	1.2	1.2	14.7	13.5	14.1	110/80	92
33b	415514s	ASLAM.S	25	M	1.8	1.8	1.8	17.4	14.8	16.1	2.2	2.4	2.3	15.7	15.7	15.7	110/80	93
34b	265973s	ANAND KUMAR. V	27	M	2.3	2.3	2.3	20.3	18.7	19.5	2.7	2	2.35	18.8	16.7	17.8	120/80	89
35b	413588s	RADHA	55	F	1.5	2.3	1.9	14.6	15.4	15	2.2	2.2	2.2	13.6	13	13.3	120/80	91
36b	415811s	DIVYA. S	20	F	1.9	1.9	1.9	14.4	14.4	14.4	2	2.1	2.05	14.2	12.2	13.2	100/70	79
37b	413933s	NIRMAL KUMAR MONDAL	39	M	2	3.3	2.65	19.3	18	18.7	2.4	2	2.2	14	16	15	120/80	79
38b	305332s	SUSILA. P	37	F	1.2	2.6	1.9	15.9	16.3	16.1	2.5	2.4	2.45	17.1	15.9	16.5	110/70	92
39b	414548s	USHA GUPTA	57	F	1.3	1.4	1.35	17.1	16.9	17	3.5	3.5	3.5	18	18.6	18.3	110/80	99
40b	416567s	TAPAS ADAK	37	M	1	1.1	1.05	19.2	16.8	18	2	1.6	1.8	18.4	15	16.7	120/80	86
41b	415818s	JOTHI.R	36	F	2.2	2	2.1	19.9	17.4	18.7	2	1.9	1.95	17.6	15.5	16.6	110/80	80
42b	234394s	THILAKARANI.	28	f	2.7	2.7	2.7	16.7	18	17.4	2.3	2.2	2.25	16	17.8	16.9	100/60	92
43b	417473s	SANTHOSH KUMAR. N	24	M	2.2	2.2	2.2	21.8	22.4	22.1	2.6	2.6	2.6	20.4	21.4	20.9	120/80	85
44b	236516s	SHEELA. J	43	F	2.7	2.5	2.6	15.7	16.1	15.9	2.8	2.4	2.6	16.6	16.8	16.7	100/70	92